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AUGUST, 1965

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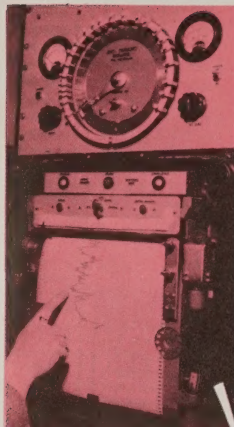
Vol. 27

No. 5

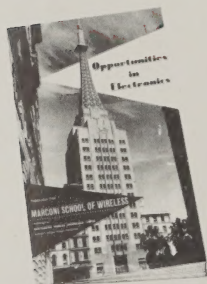
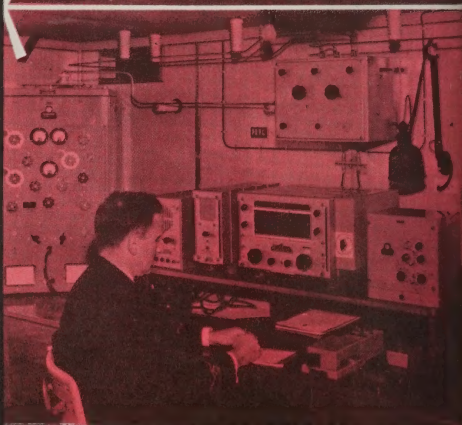
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ELECTRONICS Australia

INCORPORATING "RADIO, TELEVISION AND HOBBIES"

Volume 27, No. 5

ABC certified circulation in excess of 45,000



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Postal Address:
Box 2728, G.P.O., Sydney, Australia.

Advertising:
SELWYN SAYERS, Mgr.
BILL SUMMONS, Rep. Sydney.
GILL O'NEILL, Rep. Melbourne.
Offices: 8th Floor, 235-243 Jones Street,
Broadway, Sydney, Australia. Phone
2-0944, Ext. 2931, 2508, 2943.

Circulation:
W. CUMMING, Mgr.
Offices: 9th Floor, 235-243 Jones Street,
Broadway, Sydney, Australia. Phone
2-0944, Ext. 2505, 2509.

Subscription Rates:
See back page.

Representation:
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392 Little Collins Street. Phone 67-8131.
Brisbane—Sungrave Pty. Ltd., 78
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Newcastle, N.S.W.—Associated News-
papers Ltd., 22 Bolton Street. Phone
2-3696.
London—John Fairfax & Sons (Aust.)
Ltd., Reuter Building, 85 Fleet Street.
New York—"The Sydney Morning
Herald" Ltd., "Times Annex", 229 West
43rd Street.

Distribution:
Distributed in N.S.W. by Sungrave Pty.
Ltd., Morley Avenue, Rosebery, N.S.W.;
in Victoria by Sungrave Pty. Ltd., 392
Little Collins Street, Melbourne; in South
Australia by Sungrave Pty. Ltd., 104
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COVER PICTURE

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facturers are integrated and the
satellite thoroughly tested as a
complete space vehicle.

A PIONEER PASSES

IT would be inappropriate to let this issue go to Press without making due reference to the passing of Sir Ernest Fisk, undoubtedly the most widely known of the pioneers of the Australian radio industry.

Arriving in Australia, in 1911, as a ship's radio operator, he played a major role in furthering "wireless" technology in this part of the world. In 1918 he personally received the first direct message from England by wireless telegraphy and repeated the feat in 1924 with the first direct reception of the human voice from England.

Ernest Fisk — his knighthood came in 1937 — was one of the founders of Amalgamated Wireless (A/asia) Ltd., a company which rose to a dominant position in the Australian radio scene, with interests ranging from local and international communication, through broadcasting and consumer products, to instrumentation and research.

He was the foundation President of what is now the Institution of Radio and Electronics Engineers but, well before that, had lent extensive and practical support to the then infant "Wireless Institute of Australia."

Recognition of his stature as an executive of world standing came with his appointment, in 1951, as Managing Director of the E.M.I. empire. His passing severs yet another link with the history of radio in Australia.

So also did the passing, a few weeks ago, of another radio pioneer, John Briton, whose career substantially coincided with the radio receiver industry in Australia and who later engineered the country's first television station, TCN9, in Sydney.

While they live, pioneers have many stories to tell of the old days but we, who remain, are apt to overlook the fact that their anecdotes and their reminiscences are, in fact, history, which will pass with them if not documented and preserved. With the calendar at 1965, time is running out for those who still remember.

One can't help but wonder whether the industry is making sufficient provision for documenting its own absorbing history.

N. Williams

August, 1965

Defects in Crystals	4	Answer Man	73
Long Distance Xeroigraphy ..	9	Silicon Transistors	77
A Dipole for 1000cps	11	Audio Topics	83
Microminiature Circuits	12	Classical Reviews	85
Review — New Radiotelescope	16	Documentary Records	89
Review — Readout Display ..	19	Variety Fare	93
Scientific and Industrial News	21	Trade Reviews and Releases ..	105
A Voltmeter For Your Car	28	Amateur Band News, Notes ..	109
Standard Audio Oscilloscope ..	35	Listening Around The World ..	117
The Serviceman	45	Answers to Correspondents ..	121
A Reader Built It	51	Books and Publications	125
Dry Reed Switches	53	Classified Advertisements	127
Plating At Home	64	Index to Advertisers	128
Forum	69		

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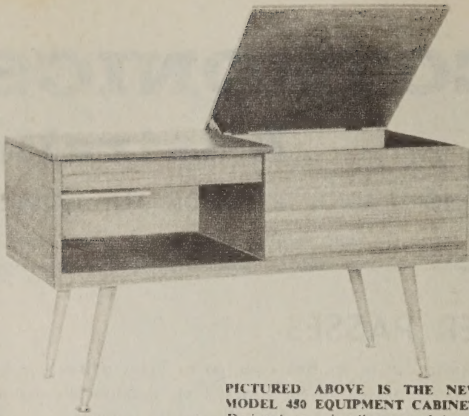
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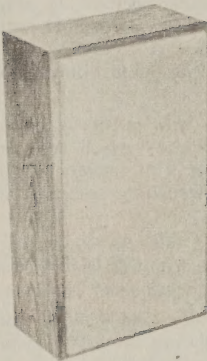
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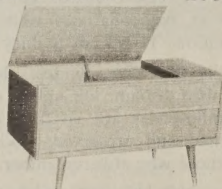
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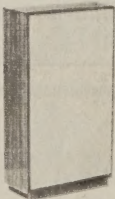
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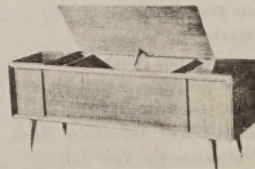
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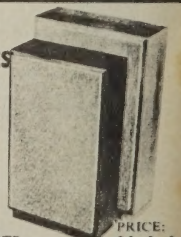
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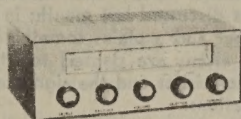


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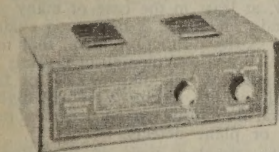
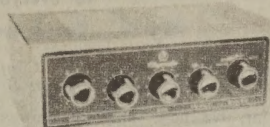
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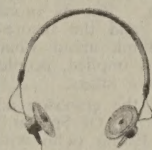
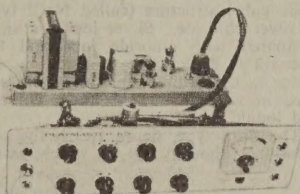
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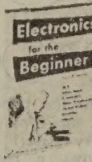
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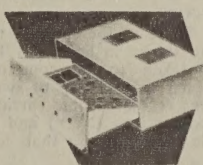
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DEFECTS IN CRYSTALS

About 400 scientists from all over the world will spend the week, August 16-21, at the Beaurepaire Centre, Melbourne University, discussing the twin subjects "Electron Diffraction" and "The Nature of Defects in Crystals." The first of these was discussed last month; in this issue, the author discusses the second subject and explains something of the internal structure of crystals, how the atoms are packed together, defects and their influence on crystal characteristics and the significance to everyday applications.

By C. K. Coogan M.Sc., Ph.D.

Publicity Officer, International Conference on "Electronic Diffraction and The Nature Of Defects In Crystals," Melbourne, 1965.

SO far, we have only spoken as if crystals were perfectly regular, and so they are to a very large extent. It is this regularity of order of atoms in crystals which impressed the first workers with X-ray diffraction. But as more questions were asked, and the theoreticians had time to think about what the experimental results implied, people realised that there were snags.

Sir Charles Darwin, the grandson of the author of "The Origin Of Species," and Professor P. P. Ewald (who will be attending the Melbourne conference) saw that, in order to get the type of X-ray diffraction patterns that were being observed from a crystal, it would have to consist of a great many domains or regions about a micron (a millionth of a metre) in size, and tilted with respect to one another up to about half a degree. In other words, the crystal contained defects.

Soon the list of different kinds of defects which had been recognised in crystals grew as long as your arm and is still growing. Some have colourful names like deathniums, excitons, crowdions, phonons, dislocations and Frenkel worms!

Three of the simplest types of defects are shown in figure 1. The host crystal is taken to be common salt, NaCl, which is made up of two interpenetrating regular cubic arrays of positive sodium ions (Na^+) and negative chloride ions (Cl^-), so that, looked at under

the microscope or a powerful magnifying glass, individual grains of salt are seen to be little cubes.

The first of these defects is the vacancy, figure 1(a) which shows a missing chloride ion.

Figure 1(b) shows an interstitial ion, that is one which is fitted into the space between the normal ions; this is not very likely to occur in NaCl itself under normal conditions, but is much more probably in another crystal of the same basic cubic structure (called NaCl type) in silver chloride. Silver ions are small compared with chloride ions and this interstitial defect is, in fact, a big factor in the ordinary photographic process, in which silver bromide, chloride and iodide are used.

The third type, figure 1(c) is the substitutional impurity ion, in which, as the

name suggests, an impurity takes the place of one of the normal ions. For example, NaCl may have a potassium ion, K^+ , sitting in a site normally occupied by an Na^+ ion. These are but a few examples of what are called point defects.

In many crystals, the ideal ratios of the component atoms is not observed (e.g. 1 Na atom to 1 Cl atom in NaCl) and these are said to be non-stoichiometric. A good example is titanium hydride, where the ideal TiH_2 composition is not attained and compounds in the range $\text{H}_{1.6}$ to $\text{H}_{1.08}$ have been observed.

Usually, these deviations are explained by the random presence of vacancies or interstitial atoms. But there is growing dissatisfaction with this point of view, at least in the case of many compounds, and there is now good evidence from X-ray diffraction work, that many grossly non-stoichiometric crystals are composed of "building blocks" of fairly simple crystal fragments joined together so that they form regular arrays of point, line or plane defects.

The simplest type of (hypothetical) example would be the case in which every second chloride ion, in the direction of the cube edges, was omitted, which would lead to a combination of $\text{Na}_{1.0158}$ and Cl. One plane in such a crystal is represented in figure 2; try to visualise the same type of structure extending into the third dimension, down

Figure 2: One plane in a sodium chloride crystal with an ordered array of cation vacancies, so that it would combine $\text{Na}_{1.0158}$ with Cl_1 . (Diagrams not otherwise acknowledged are by courtesy of T. Wignall and S. Janky, C.S.I.R.O., Division of Chemical Physics.)

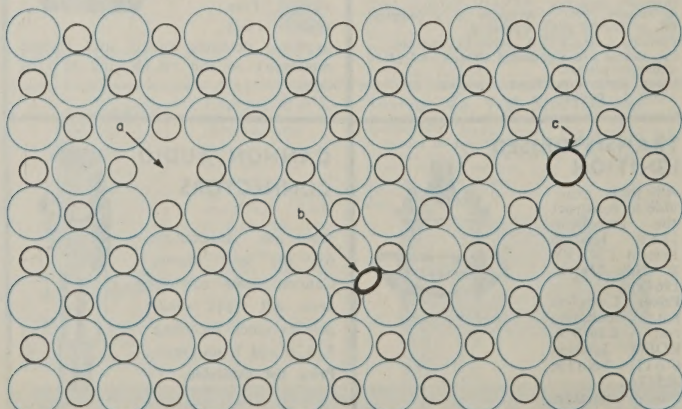
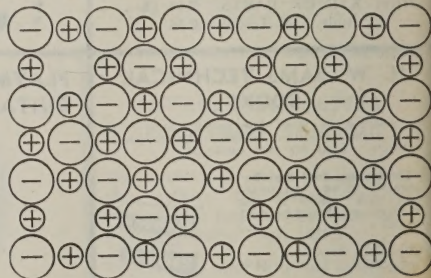


Figure 1: A two-dimensional schematic diagram of the sodium chloride crystal: the black circles are the Na positive ion and the blue circles the Cl negative ions. Defects are shown in three regions of the crystal (a) an anion (Cl^-) vacancy; (b) and interstitial cation (Na^+); (c) a substitutional cation impurity, such as K^+ .

into the paper. But do not be misled by the apparent simplicity of this imaginary case. Look at figure 3, which shows a real example, $\text{W}_{0.9}\text{Nb}_{0.1}\text{O}_6$ tungsten niobium oxide, the crystal structure of which was recently unravelled in Melbourne using X-ray diffraction as the "tool."

Then there are line defects and planar defects. Two of the most important of these are the edge dislocation and the stacking fault, representing line and plane defects respectively. The edge dislocation was predicted independently by Sir G. I. Taylor, Professor E. Orowan and Professor M. Polanyi, on theoretical grounds to explain the strength, or rather the weakness, of metals. Previous theories gave metals strengths about 1,000 times the values actually observed and the edge dislocations helped considerably to account for this anomaly.

The edge dislocation, which is shown in figure 4, can be thought of as an "extra half-plane" of atoms slipped into the crystal which accommodates it as best it can, bending its planes around the edge of the extra half plane.

Dislocations were talked about for 15

to 20 years mainly in relation to plasticity in metals before their presence was detected using the conventional optical microscope. Much of the early theoretical work on dislocations and the strength of metals was done in Bristol by Professor F. R. N. Nabarro, now of South Africa, who will be attending the conference.

Due to the distortions of the spacing between atoms around the edge of the extra half plane, impurity or interstitial atoms fit into the crystal best there, and form an atmosphere of impurities (or interstitials) around the dislocation. In certain circumstances these can coagulate to form blobs large enough to be visible under powerful optical microscopes, and hence to trace out the path of the dislocations like paper traces the path of the "hares" in a paper chase.

This was first discovered by Professor J. W. Mitchell at Bristol University in 1951, and the case he observed actually consisted of blobs of silver along the path of dislocations in silver chloride, as are formed in the photographic process. Just as everyone had predicted, the dislocations form a kind of "three-dimensional chicken wire" with branches and junctions throughout the crystal, accounting for Darwin's domains.

Another basic type of defect is the stacking fault which is common in many types of crystal. Figure 5 shows how, in a rather diagrammatic way, the layers of atoms stack ideally in a face-centred cubic crystal. This type of crystal is quite common in metals, occurring in aluminium for instance.

We need not worry about the details of this structure except that the layers can be labelled A, B and C and form a triangular net of atoms in each layer, all of which are identical except for their relative spacing laterally with respect to one another.

The normal sequence of layers is ABCABCAB... So it takes three layers before one atom is vertically below another. However, we occasionally observe that the sequence is ABCBCAB... which is called a stacking fault, so that atoms only two layers apart are vertically below one another.

These "defects" are not just deplorable mistakes spoiling otherwise perfect crystals! We now understand that they are part of the natural order of things, and that it is necessary for them to be there. And we are very fortunate that they do occur, as without them most of modern industry would have to close down!

For example, nearly every crystal grows around another type of dislocation, called a screw dislocation, and its growth does not normally seem possible otherwise. But as late as 1949 the theory of dislocation growth of crystals was bitterly opposed by those with the old school view of crystal perfection.

The electron microscope, owing to a few of the useful side effects of electron diffraction, has been a very powerful tool in looking at dislocations in metal crystals particularly. Every electron micrograph is accompanied to some extent by diffraction effects and it has been possible to interpret some of these as arising from dislocations and to trace out the line of the dislocations in the micrographs.

Not only have static pictures been possible, but our knowledge of the inside story of dislocations in metals has been spectacularly supplemented by electron microscope "movies" which

have shown how dislocations move in the crystal and multiply when a force is applied to it.

Scientists are no longer obsessed with the regularity of crystals; rather they are intrigued (and appalled) by the enormous amount to be learned about the mess of defects and complications which can exist in even the simplest crystals and the most perfect specimens obtainable in practice. Notwithstanding this, it is the overall regularity in crystals which gives the defects their properties and makes defects glaringly obvious.

It is this departure from regularity which makes defects such as dislocations visible under the electron microscope

via diffraction effects. The actual photographs of such defective regions in crystals can be very beautiful in an abstract kind of way. So fascinating are some of these pictures that when they were discovered recently by a group of artists and potters in Melbourne they immediately began to form part of their collections!

It is hard to over-emphasise the practical significance of defects in crystals. All over the world, in the last decade, special laboratories have been springing up in industry, universities, and government sponsored institutes exclusively devoted to the study of solids. The name is usually something like Basic Materials Laboratory. There is

Figure 3. A schematic representation of the crystal structure of W₈Nb₁₈O₆₉, tungsten niobium mixed oxide. Each square represents an octahedron comprising a metal atom at the centre and an oxygen atom at the six apices. The octahedra in heavy print are at a level above the light octahedra. It is basically the W₆₃ structure, with many missing oxygen atoms but no vacancies, as the structure is "concertina-ed" in on itself, and oxygen atoms are shared by some neighbouring octahedra. (Diagram by courtesy Dr A. D. Wadswley, C.S.I.R.O. Division of Mineral Chemistry.)

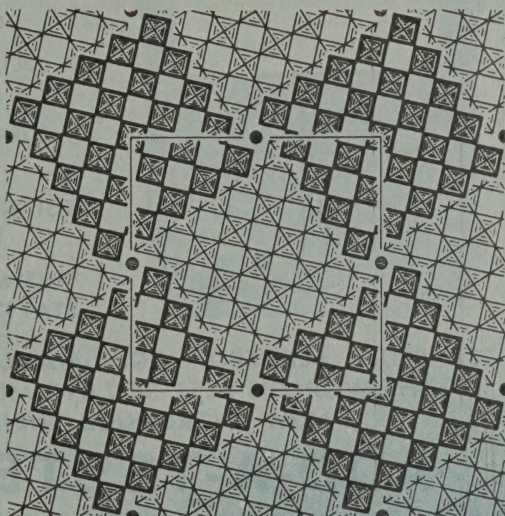


Figure 4: A perspective view looking along the line of an edge dislocation in a simple cubic crystal (if there were such a thing as a simple cubic crystal). Actual cases in metals for example are rather more complicated.

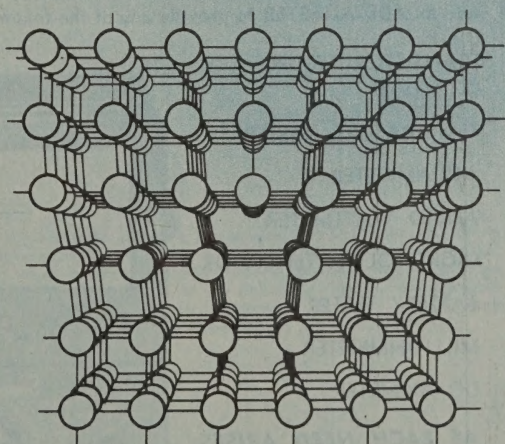
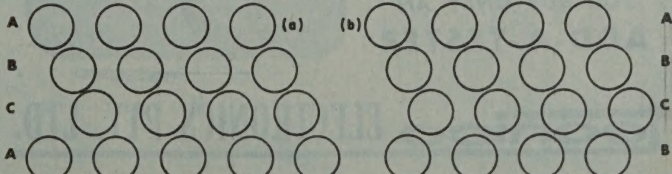
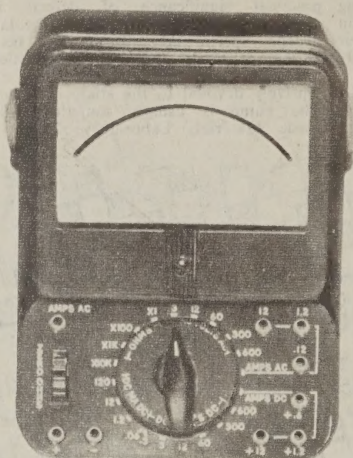


Figure 5: A stacking fault in a face-centred cubic crystal such as aluminium. The natural order of stacking of planes in this crystal is ABCABC... as in (a); with a stacking fault this becomes ABCBC... as in (b).



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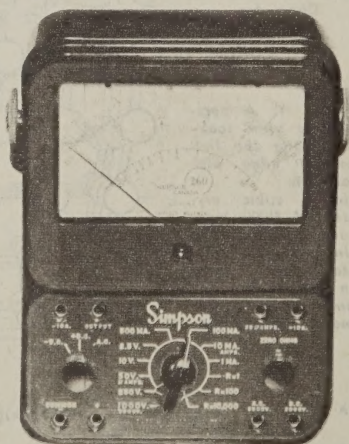
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not space to go into even a list of all the headings under which research in these laboratories is conducted, but a few examples are given below.

All who dabble with electronics know that the useful properties of the transistor and the rectifier come from substitutional impurities (in the case of germanium and silicon) diffused into germanium and silicon in which the impurity content is about one part in 100 million.

Substitutional chromium impurities in aluminium oxide crystals (colourless

An exhibition of instruments used in these fields will be set up in the Beaurepaire Centre, Melbourne University, during the conference. The exhibition will be open to the public 2-5 p.m. and 7-10 p.m. on 17-19 August and 2-5 p.m. on August 20.

sapphire) are responsible for the deep red of ruby, and make it useful as a laser crystal ("Electronics Australia," April, 1965).

The vacancy is one of the most important and ubiquitous defects in all crystals. The most far-reaching result of its presence is that it facilitates diffusion of atoms in crystals. If there were no vacancies present, and atoms had to squeeze past one another to move about the crystal, as in figure 6, diffusion would be a rather rare event due to the amount of energy it would require.

If vacancies are present on the other hand, the atoms bordering it can make a much more dignified jump into the vacancy as the amount of "squeezing past" is very much reduced, and the vacancy wanders through the crystal allowing other atoms along its path to shuffle around. It still needs a bit of effort for atoms to complete the jump into a vacancy and it only manages to do it occasionally.

All the atoms in a crystal are vibrating continuously, at frequencies in the region of a million megacycles, and their average vibrational energy is proportional to the temperature, although some can have a good deal more than the average energy. As the temperature increases, the number of "hot," or violently vibrating atoms increases and the probability of a diffusional jump occurring increases rapidly with temperature.

Most of us know to our discomfort how a transistor can be "cooked," whereupon the carefully placed impurity atoms which have been diffused into the crystal under close control, diffuse further afield when it overheats, and we look for a new transistor!

Diffusion is the basis of a huge number of industrial processes. Any chemical process that takes place in solids, such as in smelting, or sintering; heat treatment of metals; photography; all require the transport of atoms from one material into another, or from one part of a crystal to another part of it. The more our fragmentary knowledge of diffusion grows the better we will be able to control these and a thousand other processes.

Dislocations in metals, and for that matter in all crystals, are responsible for plasticity or permanent deformation when forces are applied. To a large extent this is beneficial, and allows us to work metals by forging, to cut on

lathes, and to harden them by hammering. Nowadays we have a good idea of what happens when a metal deforms, and the role dislocations take in this process.

How does the dislocation aid "slip" or plasticity to take place in a metal? Figure 7(a) shows what might have happened were there no dislocations. One plane of the crystal would have to slide over its neighbour, which would cause a great upheaval in the neighbourhood of all the immense number of atoms in both upper and lower planes, and would require very large external forces.

On the other hand, when an edge dislocation moves, as is seen in the series of schematic "snapshots" in figure 7(b), only the line of atoms, extending back into the paper, along the core of the dislocation, are seriously disturbed out of their normal type of environment at any one time and a much smaller force is required to produce plasticity.

Some time ago the question began to be asked, "What happens in materials containing no movable dislocations, and is it possible to produce them?" Partial answers came when Bell Telephone scientists began investigating the "tin whiskers" which grew spontaneously on solder joints over the years, and caused annoying faults in telephone exchanges. They found that these little whiskers, growing but of their parent metals like silver asparagus, and only a

few millimetres long, were immensely strong whereas solder and tin are notoriously weak.

Later they found that each whisker contained only one dislocation, running down the core of the whisker, and about which the crystals grew, and which contributes no plasticity to the crystal because it cannot be moved easily. Whiskers have since been found to grow, given the right conditions, on all kinds of unlikely materials, such as graphite and sapphire. The commonest example is the "efflorescence" which one often sees growing out of brickwork, looking like white fungus, which is usually due to common salt in the mortar.

We are just entering an entirely new era in metallurgy due to the measurement of the strength of tin whiskers. The new wave of strong materials, some hundreds of times stronger than steel, consist of bundles of parallel whiskers or fibres, running along the direction in which strength is desired, and "glued" together by a soft metal such as cadmium, silver or aluminium. They resemble spaghetti in a rather thick

sauce!

These new materials pose their own problems, as they cannot be cut or drilled in the conventional way, but have to be formed by something like die casting. Imagine how the spaghetti would wind up around a drill! Typical examples are fibres of aluminium oxide in aluminium, or glass fibres in silver.

Another ubiquitous defect is the F-centre, which we have not mentioned up to now. It is so named after the German Farben, meaning colour. F-centres occur in ionic crystals, like NaCl, and colour them red, blue, green and orange. F-centres consist of negative ion vacancies, into which an electron has fallen and is trapped. They can commonly result from bombarding the crystal with X-rays or gamma rays. They can congregate, by diffusing through the crystal until they meet and join other F-centres, and form regions rich in metal ions and electrons.

Eventually this breaks down into a submicroscopic speck of metal, and the metal atoms pack together in the manner of the metal and not of the ionic

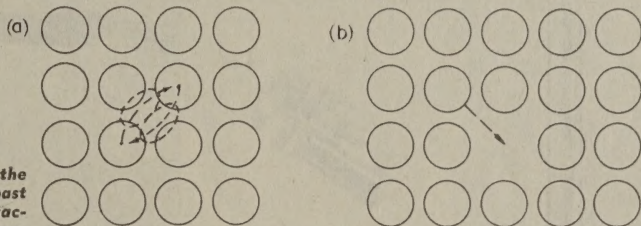


Figure 6: Diffusion in a crystal showing (a) the hypothetical case of atoms "squeezing" past atoms to exchange places, in the absence of vacancies, compared with (b) the much easier passage of an atom moving into a vacant site.

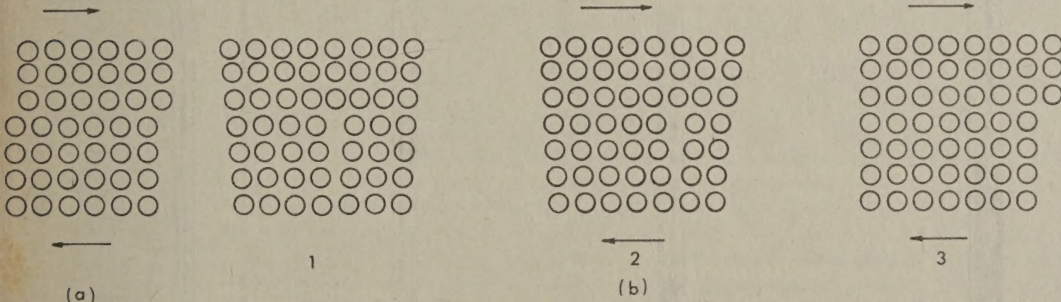


Figure 7: (a) How plasticity might occur in a crystal without dislocations. A whole plane of atoms would have to move over the plane below it, and while this was occurring all the atoms in both planes would be in grossly distorted crystal environments. (b) With an edge dislocation in the crystal (1), when a force is applied the dislocation begins to move through the crystal (2), until it passes out through a surface (3). Thus the shape of the crystal is changed permanently by applying force. As only a line of atoms, in the "core" of the dislocation, lie in grossly distorted sites, much smaller forces are needed to change the crystal shape permanently.

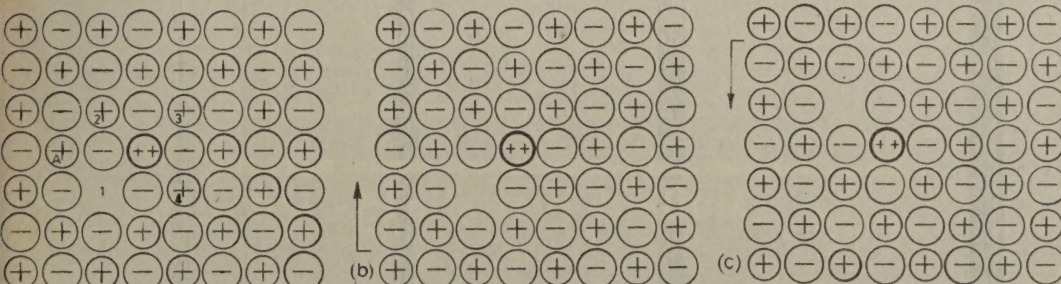
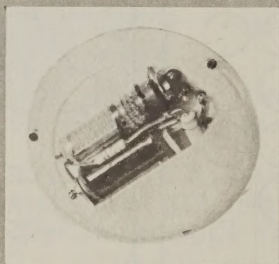


Figure 8: (a) A calcium (Ca) ion substituting for a sodium (Na) ion in NaCl, with a "compensating" vacant Na site bound to it in site 1; (b) When an electric field is applied the vacancy takes up one of the most advantageous bound positions, this being 1 or 4 in the case shown; (c) When the field is reversed, the most advantageous position is 2 or 3. The vacancy can perhaps "move" by cation A jumping into 1, and the cation at 2 jumping into the vacant site left by A. There are other possibilities in three dimensions.

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crystal of which they were formerly a part. Specks of silver like this form the photographic image in the minute crystals of a photographic emulsion.

A common type of defect which leads to interesting electrical properties is the case of a crystal of the sodium chloride type, composed of sodium ions bearing a single positive charge and chloride ions with a single negative charge, in which divalent metallic ions such as calcium can occur as a substitutional impurity. That is, it takes the place of one of the sodium ions. But the calcium ion carries a double positive charge and, if it merely replaced a sodium ion, we would have an excess of one positive charge in the crystal; to compensate one other sodium ion is omitted. The vacancy is usually in one of the nearest neighbour sodium positions as is shown in figure 8 (a).

Now, if an electric field is applied, the calcium/sodium-vacancy pair tends to align itself with the field, as it has an effective electric dipole moment, and the field does work in making the vacancy jump into an appropriate position. Of course, it is not the vacancy that jumps, but another sodium ion which by jumping into the vacancy leaves a vacancy behind, in the site it used to occupy.

As these diffusional type of jumps are dependent on temperature, the ability of the dipole to follow an alternating electric field depends on the temperature. So at very low temperatures the dielectric loss of the crystal is small, but as the temperature increases the losses increase. Incidentally, dielectric breakdown or loss of the insulating property is a very live subject.

Our last example is a brand new photographic process discovered by Professor A. J. Forty, at Bristol University, last year. Lead iodide, PbI_2 , is evaporated under vacuum by passing a heavy current through a "boat" of molybdenum containing PbI_2 until its temperature is 300-350°C. A thin film of lead iodide forms on any suitable surface, such as glass or plastic, inside the vacuum belljar.

The "film" so formed is then exposed to a bright light in the usual way, except that exposures of about 10 minutes with very bright light are necessary.

During the exposure the lead iodide film is usually kept at about 200°C, although lower temperatures are possible. A photographic image of the usual kind is formed composed of minute blobs of lead.

All this may sound very inconvenient, but it has some great advantages. No chemicals are needed, the image is not spoilt by light at normal temperatures, and the resolution, or the ability to reproduce fine detail, is much superior to the silver halide processes. Once again diffusion is of central importance, with the strong probability that F-centre aggregation is the first step in the formation of the lead speck.

It would not be fair to depart from this subject without pointing out that electron microscopy and electron diffraction are but two of the tools used by physicists and chemists in studying defects in solids. Optical spectroscopy, nuclear magnetic resonance, electron spin resonance, dielectric loss measurements and the glamorous new Mossbauer effect are just some of the other useful techniques.

There will be quite a bit for the delegates to talk about in Melbourne in August!

LONG-DISTANCE INSTANT COPY



The Xerox Corporation recently demonstrated a breakthrough in the art of graphic communications with its Long Distance Xeroxgraphy system known as LDX. The system was shown in New York earlier this year, though it was actually foreshadowed in 1962.

LDX is a system for high-speed transmission of line copy that electronically sends a document across a corridor, or across a continent. In seconds, a scanner is able to send to a printer, anything written, typed, sketched or printed. The link between these two components is a broadband transmission line (microwave channel, coaxial cable or special telephone lines).

The original document remains with the sender while the device converts an image of the document into electrical impulses and transmits them thousands of miles away or across town to a receiver. The system even verifies that the printer is ready to receive an incoming signal before the scanner will transmit a document. The printer then stands by, ready to reproduce an exact copy on ordinary bond paper in a matter of seconds.

The implications of this unique facsimile system have yet to be felt in the business world. Here are some examples:

- A West Coast representative needs a particular engineering drawing this afternoon. Feed it into the office LDX and his copy arrives moments later.
- A trucking company can load perishable cargo and get it on the road without waiting for bills of lading. The forms can be typed up while the trucks are en route and will arrive safely at the destination before the trucks.
- Facsimiles of sales orders can be transmitted directly to a central office in minutes, cutting mail delays.

The system is a combination of optics, electronics and electrostatics. A cathode-ray tube in the scanning unit sweeps across the original document. A photo-multiplier converts the light from the scanned page into electrical signals that are then sent via the broadband link to the printer unit which can be thousands of miles away. The received signals are fed to another cathode-ray tube which "redraws" the image on a selenium coated drum. The LDX copy is then reproduced in the conventional Xerographic manner. It will send up to eight 8½ x 11 in copies per minute.



Right here, we can think of twenty good ways to use new nickel cadmium cells . . . there are hundreds more

Nickel Cadmium cells are opening completely new doors to designers of portable electrical equipment. They can be used in anything from transistor radios to portable electric typewriters. They can power toothbrushes or lawn mowers. They have an infinite number of applications because they offer characteristics not found in other batteries.

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no maintenance, and no topping up. They can be used in any position, stored in any state, recharged hundreds of times. For the first time, a permanent source of portable electric power has been made available to designers and manufacturers. The uses to be found for this power source are bound only by imagination.

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Inside a makeshift shelter on a 9,000-foot-high Antarctic plateau, three Boeing men huddled over a tape recorder playing Julie Andrews' recording "I've Grown Accustomed to Your Face." Waves of music pulsed through the whiteout of the bitter Antarctic summer. Twelve miles away, the music came booming in to engineers in the scientific Stanford University field laboratory at Byrd Station.

By Wesley Robinson



Newly laid antenna cable is straightened by Ted Johnson.

ENTERTAINMENT? No. It was the first test of a 21-mile-long dipole antenna designed to collect scientific data at extremely low frequencies near one kilocycle. Other antennas using power transmission lines have dipped into the one-kilocycle region, but none of them was built specifically to study extremely low frequencies.

The Boeing men used no RF carrier equipment to transmit Miss Andrews' sentimental song. They fed the music directly from the tape recorder to the dipole antenna.

Music played no part in most of the antenna-experiment work. The bulk of the testing involved 8,000,000-watt narrow-band multiple pulses, mere microseconds long, which were directed to stations as far north as Great Whale River on Hudson Bay. A report of reception is being compiled.

Success of the whole venture hinged on careful installation of a dipole antenna excited from terminals at its centre, with two equal-length arms stretching in opposite directions on a straight line across the Antarctic plain from the makeshift central shack. For three months, Boeing engineers Robert Tighe, Ted Johnson and Art Guy had unreeling big spools of 3-inch polyethylene cable over the frozen surface in 1,000-foot segments, carefully surveying and aligning it as they went.

Their efforts paid handsome dividends: the antenna performed better than expected. Considerable new data was gathered especially below 5KC.

BASIC RESEARCH

The big Antarctic antenna will continue to be a basic research tool for many years. "The door is now open to new ionospheric, propagation and geophysical research studies," said Johnson. "For example, we now can experiment with long-distance point-to-point radio communication outside the ionosphere via whistler modes. We can study ways of improving conventional modes of communication using propagation under the ionosphere. We can do research on solar flares and perhaps eventually give predictions of intense solar storms that disrupt the earth's magnetic field. Also, we can study the electrical properties of materials deep under the Antarctic icecap."

The lower the frequency, the more stable the signal and the less likely it is to fade out during research and communication experiments. Big antenna systems reaching as low as 14 kilocycles are in operation in Maine and at Wash-

ington State's Jim Creek station, but the cost of building each of these stations was more than \$50 million.

"For \$12,000 worth of wire, we were able to build a bigger, more efficient research antenna which will operate at lower frequencies than any now in existence," said Art Guy. "It was a remarkably successful venture."

Antarctica was picked for the antenna installation because it has high, unpopulated plateaus on which wire can be laid in straight lines for miles, and a frigid coating which prevents signal loss. Next to free space, ice is the best, most abundant insulating material naturally available on earth. Generally the colder the ice, the lower the signal loss.

MOUNTAIN BOUNDARY

The gigantic Antarctic Mountains divide the continent into East and West Antarctica. East Antarctica is generally explored by the Russians, West Antarctica by the United States. The boundary is entirely non-political, however, as Antarctica is a treaty area equally owned by all nations.

The antenna location was about 12 miles from Byrd Station, roughly 450 miles from the coast and 700 miles from the South Pole. The antenna was oriented along the magnetic meridian 30 degrees east of true north.

At the antenna site, summer temperatures fluctuated between 26 degrees above and 26 below zero. No sooner had the Boeing men located their campsite and erected their small shelter than a three-day blizzard hit, burying their equipment in 10 to 20 inches of snow. It proved to be the worst storm of the trip until just before time came to break camp and return home. At that critical moment, another fierce blizzard struck.

Much of the time the men worked either in bright sunshine or a calm whiteout, a condition under which there is no horizon, no perspective and no shadows. A whiteout is caused by a combination of the unbroken white landscape and a high-altitude fog, which completely diffuses sunlight reaching the icecap.

"Visibility is excellent in a whiteout," said Johnson. "Often you can see for miles. The trouble is, if you notice something you can't recognise, you simply cannot judge if it is a huge object several miles away, or a small object a few hundred yards away."

Johnson, Tighe and Guy often worked all night long. As the sun never set there was no physical sensation of day and night.



This device is used to measure distance.



Despite the frigid temperatures, uncovering buried gear can be hot work.

Equally, taking readings can be very cold work.



You Can See Them — Just!

Microminiature Circuits

"Microminiature Circuits," "Thin Film Circuits," "Integrated Circuits," and similar terms are appearing more and more frequently in technical literature. What are these devices and where do they fit into everyday electronics picture? This article, and the one to follow, explains what it is all about in simple everyday language.



A typical micro-miniature circuit; so small that 30 will fit on an aspirin tablet.

By Elmar Laisk, M.Sc., A.M.I.R.E.E., M.I.E.E.E., A.A.I.P.

MINIATURE comes from the Latin "miniatura," for something made on a small scale. The Greek "mikros" means "very small," such as microscopic. In science, the prefix micro denotes one millionth part of a unit, as in micro-farad. Thus the mighty Greco-Roman double-deminisher "microminiaturisation" stands

for the "shrinking of the shrunken." In the space age it has become a term for tiny semiconductor chips, or even molecular groups performing electronic operations. More often, miniaturisation is used for the size reduction, whereas microminiaturisation refers to the integrated circuits.

The need for smallness in electronics was first created by hearing aids, for which miniature and then subminiature valves were made. This trend was followed half-heartedly in prewar portable radios, walkie-talkies and airborne equipment.

Miniaturisation proper was introduced during World War II. In 1943 a mortar proximity fuse was developed in sub-miniature size, and mass produced by depositing conductive and resistive inks on a ceramic substrate. This then became the large-scale start of printed circuits.

The road to real miniaturisation was opened only by the invention of the transistor in 1948. Figure 1 depicts the time sequence of inventions, which led to the present state of microminiaturisation. Just how much electronic equipment can be shrunk by various miniaturisation techniques is shown on Fig. 2.

It doesn't apply merely to show-piece shrinking. Since 1960, the production of micro-miniature devices is gradually shifting from the laboratories into the mass production departments labelled Micro Electronics, Micro Circuits, Micro Power Circuits, Unircuits, Solid Circuits, Thin Film Circuits, Monolithic Circuits, Integrated Circuits, Micrologic Circuits, Molecular Electronics and any combination of these terms.

In laboratories, the search goes on toward still tinier units; units which inspire such names as Ultra Micro-miniature Electronics, Pico Electronics, Micro-molecular, and Atomic Electronics. Perhaps the latter claimed its birth right here in Sydney when in February this year Dr Dan Haneman invented the high temperature (500° F.) germanium transistor in the Semiconductor Laboratory at the University of N.S.W.

The fact is that, in 1965, micro-miniature electronic devices or micromins are produced in quantities from tens of thousands up to millions. Among the main suppliers are Texas Instruments,

They say ...



Dr L. W. Davies,
A.W.V. Physical
Laboratory,
Rydalmere, N.S.W.

"Initial interest in integrated circuits arose from the extremely small dimensions attainable. They now appear to have prospects of a much wider impact, as more is learnt of their high reliability, and indications appear that their costs will be competitive."



Mr R. Darnell
Assist. Chief Engineer
Capacitor and
Components Div.,
Ducon Condensers
Pty. Ltd.,
Villawood, N.S.W.

"The economic conditions prevailing in Australia, and in particular the relatively low (compared with U.K., U.S.A.) allocation for defence spending, have resulted in a lag of many years in the development of thin film, integrated and solid state circuitry. Initial markets for these forms of circuitry in this country will be in professional applications as in other countries. As production techniques and production yields improve, there will be a gradual transition to the commercial markets. We believe that the initial phase will begin to gather momentum early in the next decade and that the thin film and integrated circuits will not find their way into the commercial market in significant quantities until at the earliest, the mid 1970s.

"However, planning and development of micro-circuitry must precede production by many years and a lot of research has been done on thin film circuits in

the Plessey Laboratories in the U.K. Studies have been and are being made on the application of the results of this research in Australia."



Mr M. M. Lusby,
International
Resistance Co.
(Australasia) Pty. Ltd.
Kingsgrove, N.S.W.

"Recent discussions at the several micro-circuit plants of I.R.C. and C.T.S. Corporation U.S.A. and Canada emphasise the strong position of the film-hybrid segment of micro-circuitry. Computers ideally combine monolithic packages for the highly redundant logic areas with hybrid film packages at peripheral and interface spots. Communications equipment needs the greater accuracy, isolation, and short run economy of the hybrid approach especially in linear and wide band areas not yet solved in the monolithic technology. There is room for all in this exciting new field!"

Dr D. Haneman, Head of Semiconductor Laboratory, School of Physics, University of N.S.W. (See photo page 14.)

"Eventually one would hope to achieve a packaging density of components comparable to that of the human brain.

"It is significant that nature uses an entirely different system, involving ionic currents, rather than the types man is presently developing, which involve electron currents in solids. This points to the necessity of developing organic semi-conductors. This subject is still in a very rudimentary state compared to inorganic semi-conductors, but I think it will eventually be of the greatest importance."

Fairchild, R.C.A. Motorola, I.R.C., General Electric, C.T.S., Westinghouse, Signetics and Sperry Semiconductors in U.S.A.; Elliott Automation, Ferranti Mullard, S.T.C., Plessey and Welwyn Electric in G.B.; C.S.F. and Thomson-Houston in France; Siemens, Telefunken, Lorenz and Grundig in W. Germany; Sony, Nippon Electric and others in Japan.

In Australia, the micromins will be available from Mullard, Philips, Ducon, A.W.V., I.R.C., S.T.C. and Fairchild. Research on microminiature and thin film techniques is pursued at the University of New South Wales, C.S.I.R.O. and in the Application Laboratories of Philips, Mullard, A.W.V., Ducon, I.R.C. and Fairchild.

The demand for micromins, "at any cost" was first brought about by military and space age requirements. The space in missiles, deep space probes, satellites and airborne equipment is fantastically expensive, in some instances perhaps £5m. per cubic foot. But an awful lot of electronic functions were required and the answer was microminiaturisation. It had to be absolutely failure-free, at any cost. In consequence, the initial micromins were very expensive.

Automation has reduced the cost of micromins and for the first time this year they appear competitively on the consumer market. The bulk of the micromins goes into computers. However, in 1966, they will be on the way into car radios, TV sets, Hi-Fi sound equipment, program-controlled home appliances, medical equipment such as heart pacemakers, tiny transmitters and receivers, private telephone exchanges, process-control computers and automated factories.

There are three inherent qualities, which make micromins so attractive: Smallness, potential cheapness in huge quantities—although they can't be called cheap yet—and a vastly superior reliability. The most blessed of these is the reliability.

A failure in the electronic equipment of a defence missile, an aircraft, a warning radar, a manned satellite, or a heart pacemaker, is likely to end in catastrophe; a fact which inspired a popular electronics jingle:

A little malfunction may breed mischance;

From a fault in a diode, a relay failed;
For want of a relay, a radar failed;
For want of a radar, a missile turned;
For want of a missile, a city burned.

Elsewhere, a failure in electronic components may cost a fortune, for instance if it occurs in a satellite, transatlantic cable or an unmanned early warning radar. In any other electronic equipment, reliability is the very basis of economy. A large computer employing half a million transistors and diodes, several millions of other components and many millions of inter-connections must run 24 hours a day, 365 days a year. Even a failure rate of one in 1 million per 1,000 hours will ruin its economy.

In the pre-transistor era, the best means for improving reliability of a device was either reducing the number of its components or increasing their reliability. Here, the reliability means the probability that a component will perform its purpose for the period of time intended, say 1,000 hours. If, for instance, during this period one capaci-

tor out of 10,000 breaks down, then the failure rate of the capacitors is 1:10,000 and their reliability $9999/10,000 = 0.9999$. Such a reliability figure is given for every component and is always less than 1, which denotes absolute reliability.

According to the theory of statistics, the reliability of a device drops quickly with the increasing number of components. Even a small computer having a component reliability of 0.9999 per 1,000 hours is likely to break down hourly. It would be absolutely unsuitable for any vital purpose.

There remains then the expensive way to better reliability by duplicating or even triplicating everything, that is—by redundancy. This is nature's own way to reliability. There are about 10,000,000,000 nerve cells, neurons, in the human brain, joined with 200,000,000,

000,000,000,000 inter-connections into a huge bionic computer. Although thousands of neurons die daily, the brain action never stops, since the functions of failing cells are taken over by others. But any such large redundancy will become prohibitively expensive even in survival equipment.

The cheapest way to extreme reliability is with solid state devices: transistors, diodes, composite thin films and molecular groups. All these are best produced by microminiature techniques and possess then a vastly superior reliability. A failure rate of one in 10,000,000 serves as a typical example for their reliability and a packaging density of 500,000 components in one cubic foot for smallness.

However, as the circuits are made smaller the leads and joints may occupy 95 per cent of the volume and become

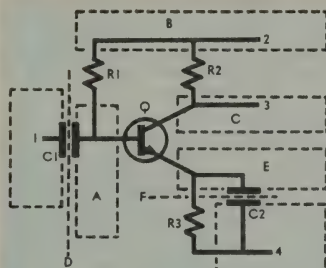
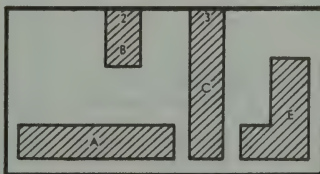
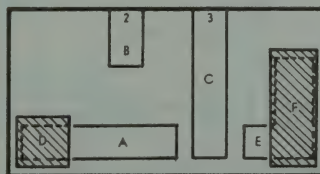


Figure 3: Basic steps in making an integrated thin film circuit. (1) Circuit diagram of an amplifier is laid out: Q—planar silicon pnp transistor; resistors $R1=100$ ohms, $R2=2.2K$, $R3=50K$; capacitors $C1=0.01\mu F$, $C2=0.1\mu F$. Conductors: lands A, B, C, E; lands A and E serve also as base electrodes for capacitors $C1$ and $C2$; terminals, input 1-4, output 3-4, battery 2-4. D and F denote dielectric layers.

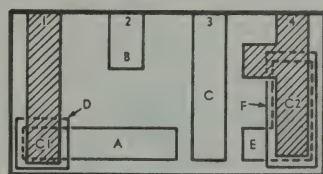


(2) The surface of the ceramic or glass substrate is polished and cleaned. Then a thin metal (aluminum) film is deposited on it and subsequently coated with KPR photo resist layer. This is exposed through a negative mask and unexposed areas are etched away, leaving conducting lands A, B, C and E.

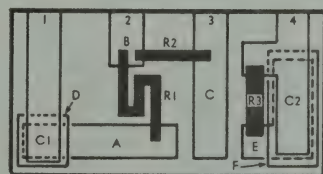


(3) The clean surface is again coated with a photo resist layer and exposed through a positive mask so

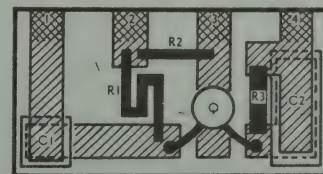
that a thin silicon dioxide layer can be deposited on lands D and F. For 6 Volt operation the thickness of the silicon oxide layer should be at least $1000\text{\AA}$ or 4 micro-inches.



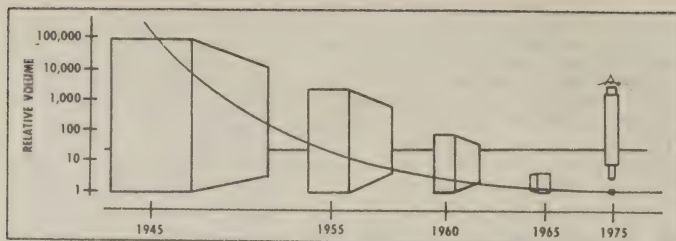
(4) The cleaned substrate is again coated with photo resist and exposed through a mask made for the deposition of counter electrodes $C1$ and $C2$. These are usually of the order of $1000-3000\text{\AA}$ thick. The effective capacitor area is the overlap area of top and bottom electrodes.



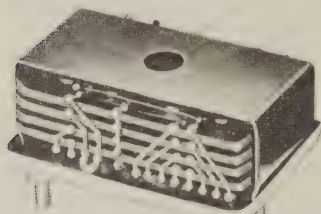
(5) The photo resist and chemical etching procedure is repeated, employing another mask for depositing thin film resistors $R1$, $R2$, $R3$. Often, this step may come first.



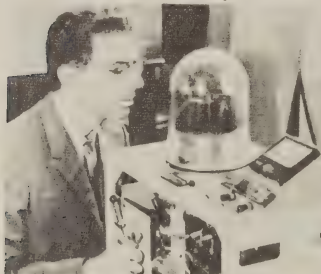
(6) Finally, the transistor Q is attached to the circuit either by soldering, micro-welding or thermo compression bonding technique. The terminals 1, 2, 3, 4 are either tinned or plated for strength. The whole unit is then tested and encapsulated. Hundreds of such circuits can be made on a single substrate in one go.



Volume reduction of complex electronic devices has been quite dramatic over the last two decades, and may be equally so in the next decade.



A microminiature module containing four substrates, each 3cm x 2cm. It contains approximately 30 semiconductors and 70 other components. (Mullard-Australia Pty. Ltd.)



Dr Dan Haneman who recently developed a high temperature transistor which represents a significant contribution to solid state physics.

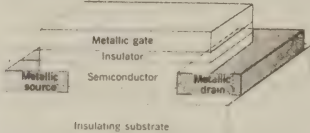


Figure 4: The structure of the TFT (Thin Film Transistor). (From "IEEE Spectrum.")

main source of faults, as in printed circuits of transistor radios.

Solder joints and pigtails can be eliminated in an integrated circuit, in which resistors and capacitors are made as part of the wiring. As there are no discrete components, no assembling, no soldering, then the integrated circuits can be made by photo-lithographic technique in microscopic sizes.

There are two preferred methods of producing integrated micro-miniature circuits: thin film and solid circuit technologies. Hybrid circuits are made by a combined technology.

Thin film micro-miniature circuits are made in somewhat similar manner to that used in printed circuit boards, however, in much smaller scale. All connections, resistors, capacitors and inductors are in the form of very thin films deposited on ceramic or plastic substrate by means of suitable masks.

Film layers less than 10,000 Angstrom ($\text{\AA}$) or 40 micro-inch thick are

considered thin. Usually, the thickness of "thin films" is about 1000 $\text{\AA}$ or less.

First of all, the circuit is laid out in the best manner for depositing capacitors, resistors, coils and their interconnections, as shown in Figure 3. Then silk screen or photographic masks are prepared for making either a single circuit or a pattern for hundreds of circuits on a single substrate.

Thin layers are made mostly on glass substrate either by vapour phase deposition or sputtering. These methods require vacuum equipment. However, thicker films can be silk screened on an alumina substrate and kiln fired. Such "thick film" circuits exhibit extra ruggedness and much higher power dissipation than the very thin film ones.

Aluminium, copper and alloy films serve as conductors and connectors. Resistors are made by depositing tin oxide, nichrome, chromium or cermet (chromium and silicon oxide) thin films at appropriate places. Resistance values from several ohms to 10M are practicable.

Usually, the required substrate area is entirely covered with thin conductive or resistive film. The latter is coated with photosensitive layer which is then exposed through a negative mask with appropriate pattern. The non-exposed portions of the thin film are then removed by chemical etching, as in photolithography. The process can be repeated for the deposition of other components. For capacitors, at least three masks are required. First, a thin aluminium film is deposited for the base electrode. Then this base electrode is coated with a thin film of dielectric, say silicon oxide or aluminium dioxide made by oxidation of the surface. Finally another thin film of aluminium on top of the insulating layer serves as a counter-electrode.

The capacitance values depend on the thickness of the dielectric layer. Typically, values up to 0.1 μF per sq. inch can be made by this method. Larger values are obtained with thin tantalum films. Here the dielectric film is made by anodic oxidation of the tantalum surface on which, subsequently, a gold counter electrode is evaporated. A capacitance of 0.5pF per sq. inch or more is practicable. A typical breakdown voltage is 75 volts and leakage resistance about 10,000M.

Low value inductors are made by deposition of either thin film spirals or nickel-iron and ferrite films. Large value inductors in the form of miniature ferrite toroids have to be attached to the thin-film circuit.

All active components, such as transistors and diodes are also attached to the thin film circuits either by soldering, welding or thermo-bonding techniques. Whenever possible inductors are substituted either by crystals or selective resistance-capacitance networks, for instance in oscillator and filter micro-circuits.

However, transistors and diodes can be also made in thin film technology. A thin film transistor, TFT, is made by successive evaporations of various layers through metal masks, resulting in a thin-film structure shown in Fig. 4. The fabrication of such active devices is outlined in Part 2 of this article.

The thin film technology is advantageous for circuits having relatively many resistors and capacitors. They can be easily mass-produced at considerably lesser price than a similar discrete component printed circuit.

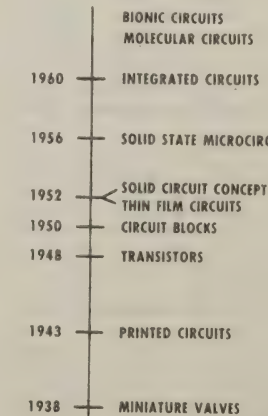
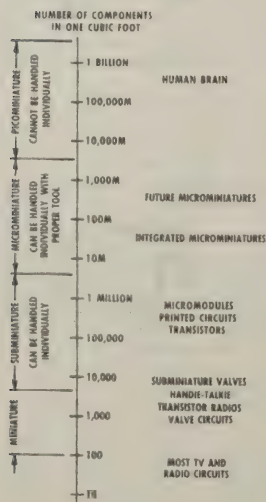


Figure 1 (above). The era of micro-miniaturisation commenced about 1943 with the development of printed wiring. Figure 2 (left). Current micro-miniature techniques are still far short of the ultimate in package density, the human brain.

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Technical Review

FRENCH ENGINEERS DESIGN NEW RADIOTELESCOPE

One of the most valuable astronomical tools devised in recent years is the radiotelescope; a unique instrument which is rapidly filling the gaps left by optical observations. The latest addition to the small group of giant instruments — Jodrell Bank, Green-Bank, Parkes, Arecibo — is at Nancay, in France, where engineers have adopted a novel approach to the many constructional problems in this field.

IN the plain of the Sologne district, France, close to the small village of Nancay, south of Orleans, two gigantic metal panels rise above the pine and birchwoods. It is the site of the Radioastronomy Station, in existence for some 10 years now, where the astronomers of the Meudon Observatory have set up their instruments. The two panels are the reflectors of a new giant radiotelescope which has recently been added to an already considerable amount of equipment; the Nancay station has long enjoyed world-wide renown owing to its solar interferometer, whose 32 antennae cover almost two kilometres.

The new radiotelescope, which is one of the largest and probably the most sensitive in existence today, enables French radio astronomers to tackle, with every chance of success, the study of distant galaxies and mysterious sources of radio waves.

It is some years since radioastronomers began to draw attention by building

gigantic instruments. The first of these, completed in 1957 at Jodrell Bank in England, consisted of a large parabolic mirror 75M in diameter. A fairly similar instrument, although more accurate, has been built by Australian radioastronomers and another, which can be directed in a single plane, is at Green-Bank, in the U.S.A. Finally, other instruments based on a different principle were built last year, also deserving the term "giant." The large 300M diameter fixed bowl at Arecibo in Puerto Rico is particularly worth mentioning. These instruments are indispensable if extragalactic radio wave radiation is to be studied, and France could not be left without one.

In 1958 the radioastronomy team of the Meudon Observatory, headed by J. F. Denisse, decided to build a large radiotelescope. The instrument of their choice differed somewhat from previous ones, combining the advantages of a very large surface and the possibility of

taking prolonged shots of the astral bodies observed, with that of a considerably lower cost than for parabolas which could be pointed in all directions.

The simplest design of a radiotelescope consists of a large parabolic reflector concentrating the radiowaves at its focus, where a small antenna picks them up and sends them to the receiver. To be able to aim at any astral body in the sky, this parabola must be completely mobile. However, when structures weighing several hundred tons have to be moved, and what is more, without the slightest distortion, the problem is by no means simple.

This is why the Nancay radiotelescope works on a different principle. The parabolic reflector is replaced by a fixed reflector forming part of a sphere. It is this reflector that causes the rays to converge on the focal antenna. However, as it cannot be aimed at will, a flat reflector which can swivel around a horizontal axis is added, sending onto it the rays from the radio source.

In addition by suitably shifting the focal antenna, it is possible to track an astral body in the celestial sphere, i.e. to take shots of up to an hour's duration, and hence to increase the sensitivity of the observations, in the same way as exposure time increases the ability of photographic plates to record light in the visible spectrum.

Two immense structures had to be built, one curved and stationary, 35M high and 30M long, the other flat, 40M high and 200M long, but inclinable at will.

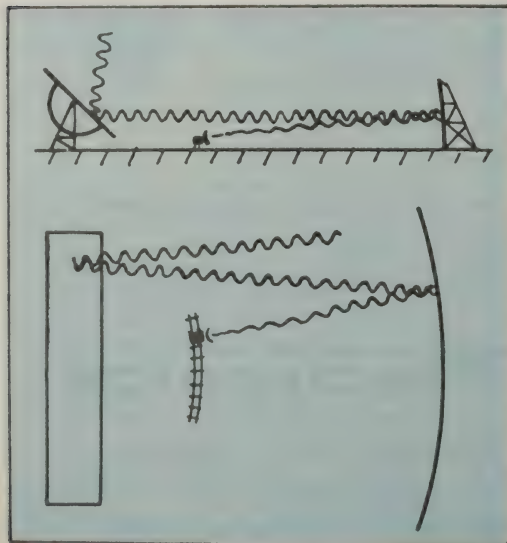
These dimensions may not seem large to builders of bridges, dams or steel frame buildings. However, the requirements of radioastronomers as regards the accuracy of the surfaces are such that it is becoming a very difficult task to construct a good radiotelescope.

In the case of the Nancay radiotelescope, it was required that at no point on the 18,500M² of surface was there to be a difference of over 1cM from the theoretical surface, regardless of temperature or wind pressure. This represented an entirely new problem for the builders of the metal frame.

The design and construction of the Nancay radiotelescope were entrusted to the Compagnie Francaise d'Entreprises, who successfully completed the project with a better accuracy than that called for.

The fixed reflector is a portion of a sphere with a radius of 560M. The

(Continued on Page 19)



A simplified diagram of the Nancay radiotelescope. Radio waves emitted by the astral body are first reflected from the planar surface, which directs them onto the spherical mirror, and then to an antenna located at the focal point. The antenna moves on a curved railway track to follow the celestial "movement."

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DIRECT READOUT

DISPLAY USES STROBE LIGHT

The increasing popularity of direct readout displays has resulted in many designs for this form of presentation. One of the latest systems employs a rotating drum of figures and a high speed flash tube to "freeze" their movement at the appropriate instant.

THE stroboscope, or speedlight, can make whirling gears and turbine blades stand still for inspection. Now the Raytheon Co. is using the same techniques to generate flickerless displays.

Fewer components, low operating power and high reliability are the result of coupling the stroboscopic principle with time-sharing of electronic circuits in the Datastrobe, a new readout device.

The company also sees advantages of simplicity and versatility over other projection readouts and over glow discharge, electroluminescent, electro-mechanical and edgelighted displays. Datastrobe needs no amplifiers, switches, relays or other mechanical devices for intermittent motion. Any type of character or symbol can be etched into the drum. The optics permits printout, including microfilming.

Datastrobe uses rotating drums, a xenon flash lamp; all-solid-state circuits; and an optical projection system, to produce a high-contrast, white-on-black multidigit display from binary coded decimal (BCD) input signals.

The flash tube is surrounded by a continuously rotating cylinder, which has transparent characters on it. The tube replaces as many as 66 incandescent bulbs in conventional project displays.

The readout operates directly from the four-bit BCD input, using a one-volt signal and four milliamperes per bit. The basic device can be modified to give full alphanumeric or other symbols in any number of columns. In the first production model, the numbers will be five-eighths of an inch high.

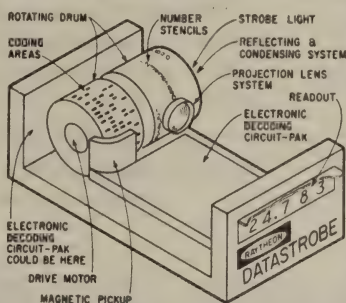
Datastrobe's time-shared, all-solid-state logic reduces the number of components. This means increased reliability at lower cost, according to Raytheon's engineers. The decoding system works so that either the correct readout is given or the device fails. "Erroneous readouts are virtually impossible," says a Raytheon design engineer.

In the first production model, two drums are used, one with coding and the other with six columns of characters etched into it. Both drums are mounted on the same shaft, and rotate at 2,500 rpm.

The basic Datastrobe accepts up to six columns of parallel, four-bit BCD information directly from the user's output. This information is serialised by the gating logic, actuated by signals from its drum column pickup. As each column comes to the proper position, the corresponding four bits are supplied to the single decoder-comparator circuit. When the desired number is in the viewing area, a trigger pulse from this circuit fires the flash tube.

Because of the high scanning rate, the six-digit presentation appears on the screen in parallel as a sharp, high-contrast, flickerless display. The decoder in the first model uses a reluctance type pickup of voltages in an 8-4-2-1 code.

The time-sharing principle permits low voltage, low current operation. A six-column readout has a maximum of



Numbers for display are carried on the drum in stencil form. The strobe light is inside the drum and the lens projects the image onto the display panel.

four bits energised at any one time. This time-sharing of a single tube and single decoding logic circuit over all six character-columns reportedly gives advantages in reliability and economics over systems which require a separate decoding matrix per column or a separate strobe tube per column.

The rotating drums, Datastrobe's only mechanical moving parts, require no close speed control, the logic being self-synchronising. No brushes or rubbing contacts are used, and no gears. The six-digit display is expandable to 12 by putting two drums on a single shaft.

The Datastrobe inherently lends itself to customising, so prices will vary a good deal. A basic unit, without accessories or special features, such as memory, is expected to sell for 50 or 60 dollars per character.

Applications are being explored in radar range readout, industrial process control, flight control displays, and navigation system readouts. Datastrobe is considered especially attractive for on-the-bridge displays aboard automated ships. Only four bits per digit are required for input and this significantly reduces the number of wires needed from remote data points.

("Electronics" No. 5 Vol. 38.)

Telescope—cont.

framework consists of a series of pylons 35M high set out every 10M and rigidly connected together. Since the structure is stationary, it was not too difficult to erect.

It was a different matter for the plane reflector, which had to swivel around a horizontal axis and whose inclination had to be set within an accuracy of one minute of arc.

It consists of 10 independent panels 40M high and 20M long, whose axes are carried on ball-bearings. The panels are rotated by meshing pinions driven by a winch into a semi-circular chain attached to the panels. Two speeds are employed 6° per minute for large movements and 6 minutes of arc per minute for small rotating movements required for accurate location.

The surface is formed by a lattice with a 12.5MM welded mesh forming a good reflector for radiowaves with a wavelength of over a few centimetres. This lattice is placed under considerable tension, by stretching it on cables attached to the structures. The surfaces were checked, as also was the siting of the radiotelescope, by a team of specialists from the National Geographical Institute.

At the present time, the radio-astronomers are putting the final touches to their receivers and the antenna system, which enables the astral bodies to be followed at the focus. This system is fairly complex. When the source observed moves in the celestial sphere owing to the daily movement, its image in the focus of the instrument shifts through a trajectory which depends on the declination of the source. This trajectory must correspond to that of the small antenna designed to detect the

waves, which, at Nancay, is a horn antenna, with a height five times its width. This horn had to be mounted on a carriage travelling on rails 100M long running between the two reflectors, concentric with the fixed mirror. In order to follow an image through its vertical motion, the horn also had to be mounted on a hoist allowing a 1.5M movement.

The vertical and horizontal movements of the horn depend on the radio source observed. They must be made with very great accuracy if the source is to remain within the field of observation of the antenna, i.e., within its receiving lobe.

To achieve this, a device was developed employing punched tape, enabling a positioning order to be relayed to the carriage, with two coordinates every 30 seconds. The position of the carriage, monitored by servo-mechanisms, is known to within a few millimetres. This method makes for great flexibility in the observations. Indeed, a single source can be observed constantly for an hour, or made to cross in succession through the lobe by shifting the carriage every three or four minutes, or be made to cross the lobe faster, by moving the image in the opposite direction. In addition, astral bodies with different motions than those of the stars, such as the moon or planets, or even space probes sent to explore the solar system, can be tracked.

There were two construction stages. The first stage, covering a fifth of the total surface, was completed in 1961. This stage enabled highly interesting observations to be made, and in particular gave an accurate idea of the potentials of the instrument. Once this initial section had provided full satisfaction, the work was continued and the surfaces increased to their final dimensions. This work has now been completed.

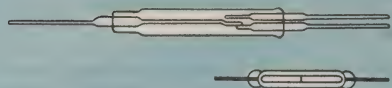
("French Technical Bulletin" No. 4, 1965)



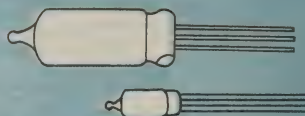
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These products of Hivac Limited are among today's miniature works of art . . . the care and precision moulded into their manufacture, backed by extensive R. & D., ensure products of the highest standard of reliability.

Informative technical literature on all Hivac products including miniature and filamentary indicator lamps is available from Ducon Industries Limited



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COLD CATHODE TUBES

Hivac dry reed relay inserts offer you some remarkable characteristics. For example, being sealed against any environment, their gold-plated contacts have a life generally better than 100 million operations. They offer high speed operation—better than 1 millisecond. Their contact resistance is very low—less than 50 milliohms. Types are available handling up to 1 Amp. Electromagnetic, magnetic and change-over operation make dry reed relay inserts the most reliable and versatile contacts available.

It will pay you to think of cold cathode tubes for a very wide range of applications. Look at what they offer: *versatile switching, reliability, simplicity* and (often a most valuable quality) *self indication of operation*. Add to this low cost and delivery from stock in any reasonable quantity; this is why more and more designers are turning to cold cathode tubes for automatic control, computing, data handling, telephone switching, and numerous other applications.

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SCIENTIFIC AND INDUSTRIAL NEWS

Precision Synchros

Synchros in International frame size 08 have been added to the comprehensive range of precision servo components designed and manufactured by Vactric Control Equipment Ltd. Control transmitters, control transformers and control differential transmitters are included in the new range.

The synchros are designed to meet the British Specification DEF.148 and the American Specification MIL-S-20708A which, as applicable, require an endurance test of 1,200 hours in the ambient temperature range -55 degrees C. to $+85$ degrees C., an altitude test of up to 100,000ft and a temperature test of -55 degrees C. to $+125$ degrees C. Following Vactric's normal practice, some of the specification requirements are exceeded due to advanced techniques used in the design and construction of the components.

For these synchros, the maximum electrical error is seven minutes of arc and the operating frequency is 400cps. For the control transformer and control differential transmitter, the nominal primary voltage (stator line to line) is 11.8 volts, while for the control transmitter it is 26 volts. Full electrical data and performance details are available on request.

(Aust. Agents: Ronald J. T. Payne Pty. Ltd., 385-387 Bridge Rd, Richmond, Victoria.)

Battery Tester

Litton Industries' Atherton division, Minneapolis, has introduced a "Battery Analyst" battery tester which has three major design advances enabling it to test batteries more rapidly and accurately than other testers. The new Litton 303 "Battery Analyst" tester can instantly test all run-down batteries (including the new solid-top batteries) without first charging the battery; can accurately test batteries at any temperature from zero to 125 degrees without complicated temperature calculations; and tests all batteries more accurately because it compensates for various ampere hour sizes.

Litton describes the "Battery Analyst" tester as a "complete, portable battery laboratory" because it indicates condition of the battery, percentage of charge, remaining ampere hour capacity, and checks for shorts and for the condition of the vehicle's alternator and generator voltage regulator. (Litton Industries, Atherton division, 2530 North Second Street, Minneapolis, Minn., U.S.A.).

Sticky Tape Clears Floors

Floor rollers faced with adhesive plastic tape are said to pick up dust, lint, crumbs and even broken glass. The "Floor-care" roller is made by Helmac Products Corporation, of Box 73, Flint 1, Michigan. It is sold with a 30-foot roll of tape which can be torn off and applied when the old tape has lost its stickiness.

Rubber Blades

Rubber cutting blades for rotary lawn mowers are the latest in a series of innovations seeking to make the mower safer to use. The rubber blade, made by the Safety Research Corporation, of College Park, Georgia, is said to cut grass adequately. At the same time, it bends when it strikes rock or glass.

Detecting Cable Faults

Development of a device for the automatic and continuous detection of faults in the insulating sheath of a cable as it emerges from the extrusion machine producing it is claimed by Trefmetaux, 28 Rue de Madrid, Paris. Metal brushes, in contact with the sheath, rotate as the cable emerges from the extrusion die and follow a helical path along it. The current carried by the brushes rises immediately a fault is traversed and is shown by an ammeter.

Protecting Metal

Clear self-adhesive plastics film has been found to have a very useful application in the aircraft industry. It is being used to protect both the surfaces of metal components and the exterior of complete aircraft from damage which could be caused by tools and equipment during construction.

The film is also used to protect expensive metal billets from flying swarf while machining is taking place and for covering wing sections so that they can be walked over without any damage being caused. One of the main users of the material is the De Havilland Division of Hawker Siddeley Aviation. Made by the Fablon Division of Commercial Plastics, Berkeley Square House, Berkeley Square, London, W.1, the film is supplied in 3-foot wide rolls.

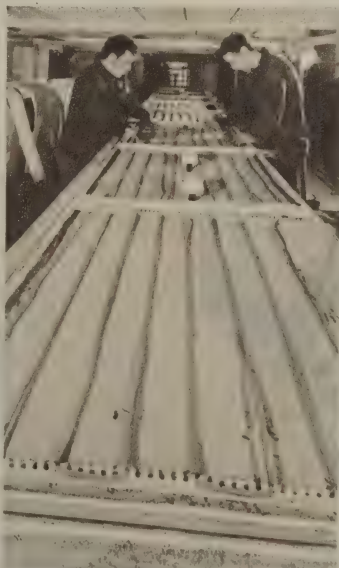
Tiny Hearing Aid

A tiny solid state circuit originally designed for use in satellites forms the basis for a new British hearing aid which weighs only a quarter of an ounce. The unit, which can be clipped to the earpiece of a pair of spectacles or simply hooked behind an ear, has controls to suppress background noise and vary the volume level. (Bernatone Ltd., Lancaster Road, High Wycombe, Buckinghamshire, England. Australian Agent: O.P.S.M. Hearing Aids Pty. Ltd., 174 King Street, Sydney.)

Radar Interrogator System

An entirely new secondary radar system, Secar, developed jointly by The Marconi Company and Compagnie Francaise Thomson Houston (C.F.T.H.), was demonstrated recently under full operating conditions at Marconi's Rivenhall Establishment in Essex, England. Secar provides a comprehensive data link between an air-traffic controller and any aircraft fitted with a secondary radar transponder. Vital information concerning position and movement can be extracted automatically from the aircraft by this system, without attention from the aircrew.

This extremely versatile equipment, the most advanced of its type in the world, can interrogate on all civil and military



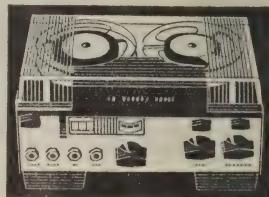
Here's one situation where "hot" money is the order of the day. Beneath the 2-inch thick marble counter of the reconstructed Swiss Bank Corporation in London, rubber sheathed cables, dissipating 16.9 watts per square foot will keep the surface temperature to between 85 and 95 degrees F. (British Insulated Callender's Cables Ltd., 21 Bloomsbury St., London, WC1.)

WHATEVER YOUR ASSIGNMENT — TAKE THE FI-CORD 202

PORTABLE BATTERY/MAINS RECORDER—
so much in so little space

Another assignment completed— thanks to the compact versatility of the Fi-Cord 202! The Fi-Cord 202 caters for the most exacting professional and the enthusiastic amateur — whether you are in the studio or out on a job the Fi-Cord 202 places high fidelity recording at your fingertips. And with this wonderful precision machine you enjoy all the advantages of a full size recorder in a compact unit weighing only 6¾ lbs. The Fi-Cord 202 offers you absolute reliability — around 300 of these feature packed Fi-Cord recorders are in daily use by the Australian broadcasting and television industry!

The Fi-Cord 202 may also be operated from standard torch cells if necessary — so that no matter where you are you have 100% security in your power supply. Main features of the 202 include:— * 2 speeds — 7½ and 3½ i.p.s. * Standard 4" spools * Vu-meter * Fast forward wind * Fast rewind * Resettable counter * Manual volume control * Built-in loudspeaker * Sockets for microphone, extension speaker and remote control * Safety record switch * Easy-load battery cassettes * Battery warning lamp * Mains input optional * Accessories available: Carrying case, a wide choice of Beyer microphones, power packs for the mains and the car.



Contact any office or representative of Simon Gray Pty. Ltd. for details and technical data on this remarkable professional recorder. Sales and service facilities are available in all states. Whatever your assignment — take the Fi-Cord 202!

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Sydney Office: 26 Ridge Street, North Sydney, N.S.W. Tel. 92 3890.

INTERSTATE REPRESENTATIVES:

N.S.W.: Audio Engineers Pty. Ltd., 342-344 Kent Street, Sydney. Tel. 29 6731
S.A.: Ellico Sales Pty. Ltd., 233 Rundle Street, Adelaide. Tel. 23 3450
Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1014
W.A.: Athol M. Hill, 613-615 Wellington Street, Perth. Tel. 21 7861
Tas.: K. W. McCulloch Pty. Ltd., 109 York Street, Launceston. Tel. 2 5322
A.C.T.: Australian Physical Laboratories, P.O. Box 225, Canberra City.
Tel. 4 3010 (Mr. J. E. Howe)
N.T.: Plitzner's Music House, Smith Street, Darwin. Tel. 3801



modes and ensures that transponders are only triggered over the narrow main interrogation beam. The complete system is fully transistorised, with the exception of the high-power output stage of the interrogator transmitter. It meets all foreseeable requirements and exceeds the existing ICAO recommendations.

Secar works simply by transmitting interrogation signals to the aircraft from a ground station. These signals are received by a special airborne equipment (a transponder), which will then automatically transmit coded replies to such questions as "Who are you?", "What is your height?", etc. (The Marconi Company Ltd., Chalmers, Essex, England. Australian Agent: A.W.A. Ltd., Engineering Products Division, 47 York Street, Sydney, N.S.W.)

High-powered Fans

Completely new concepts in fan-driven ventilation are announced by Colt Ventilation and Heating, Surbiton, Surrey, England. With them the company believes it can cut the cost of powered ventilation by as much as 50 per cent. In other words, at the same revolutions per minute the fans can move twice the volume of air, with a considerable drop in noise.

There are, in general, two types, called Hurricane and Typhoon. They are manufactured in several sizes and in one of two materials—aluminium or glass fibre. The Hurricane is described as a "low-silhouette" unit. Fitted into a wall, there is an outside cowl for weather protection and shutters that seal a building when the fans are not running.

The Typhoon is for use upward—in a roof or ceiling, for example. In this unit there are four specially designed blades which shut down on openings when not in use.

With the Typhoon upward type, the flow of air being extracted from a building prevents even heavy rain from interfering when the fan is running. All fan motors of both types are guaranteed for 10 years.

Aircraft Fault Detection

Lockheed recently outlined plans for giving aircraft "instant physicals" while in flight—thereby saving thousands of hours of down time, and increasing airlift productivity for a fleet of transport aircraft. Relayed to the flight engineer's station through an automatic printer and oscilloscope, pulse readings from more than 1,000 test points throughout the aircraft structure can provide an immediate "physical examination."

They pinpoint, and in some cases anticipate, malfunctions in engines, landing gear and brakes, and in the electrical, environmental, flight control, avionics, and instrument systems. It presents graphically to the flight engineer such information as the errant unit's name, location, and part number; the time and special tools (if any) needed for replacement. And it even



reports if the aeroplane carries a spare aboard for in-flight replacement. Thus, the crew can either make repairs in-flight or alert ground crews to have specific parts ready.

Flexible Laminate

A significant achievement in the world of plastics is the introduction of a flexible grade of copper-clad laminate, based on polyester film, which has many uses in the electrical and electronics industries, and in automobile wiring.

Printed circuits produced from this grade of laminate may be coiled and folded, and need not, therefore, be limited to a single plane in the same manner as circuits produced from rigid copper-clad laminated sheet. This feature allows the size of the assembly to be considerably reduced, and has applications in computer wiring and memory units, telephone and switchboard wiring and as car dashboard panels, as well as radio and domestic appliances. (Bakelite Ltd., 12-18 Grosvenor Gardens, London, S.W.1. Australian Agents: O. H. O'Brien Pty. Ltd., 116-176 Parramatta Road, Burwood, N.S.W.)

Solders At High Speed

Automatic equipment has been introduced in Canada for soldering armature windings to commutator segments. Armatures travel at a continuous speed through the system, being rotated as they pass the flux and soldering waves. Cooled, soldered armatures are released automatically and pass on to a varnishing operation. A machine 30 feet by 5 feet by 6 feet high made especially for a major car manufacturer handles an average of 600 armatures per hour.

The new machine developed by Electrovert Manufacturing



Mr. R. J. Boyle (right) has been elected as President of the Institution of Radio and Electronics Engineers (Aust.) for the year 1965-66. He is congratulated by the retiring President, Mr. R. W. Tremlett, at the completion of an outstanding year in the history of the I.R.E.E.

Illustrated at left is a new portable device capable of measuring moisture content to an accuracy up to 99.8 p.c. in a wide range of solids—sand, soap, clays, minced meats and so on. An accurate knowledge of moisture content is often necessary to quality control. (Associated Electrical Industries, Electronic Apparatus Division, New Parks, Leicester, England.)

Co., P.O. Box 1200 N.D.G., Montreal 28, Quebec, Canada, can be used to solder many other products where a combination of forward and rotational movements is of advantage.

Welding Light Metals

A spot-welding process for light metals, like magnesium and aluminium, has been patented in Britain. Pieces to be welded together are subjected to a momentary external load sufficient to form very fine cracks in the oxide films that always cover these metals. A welding current is then applied.

Shin-Mitsubishi Jukogy K.K., 10, 2-chrome, Marunouchi, Chiyoda-ku, Tokyo, has taken out the patent in which it is claimed that the usual pickling operation (immersion in acid) before welding is no longer required.

Colour TV Display

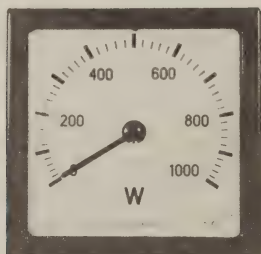
Development of a cathode ray tube system with a full colour display capability has been announced by the Guidance and Control Systems division of Litton Industries, Woodland Hills, California.

This system differs from others in that it is designed to

MODERN 240° SCALE

Decisively for exacting demands

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MADE IN AUSTRALIA under licence to the famous TRUB TAUBER WORKS, ZURICH.

UNIVERSITY, Pioneer Manufacturers of Electrical Instruments, possess SPECIAL experience and knowledge of the requirements of industry and power supply authorities — gained over a period of 30 years.

ELECTRICAL MEASURING INSTRUMENTS —with a guarantee of overall excellence

48mm.

72mm.

96mm.

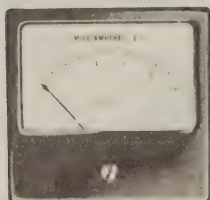
144mm.

8 inch

12 inch

for A.C.
or D.C.

PANEL METERS



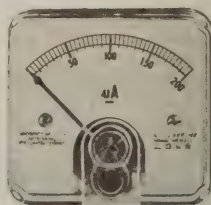
Model O4.



Model O2.



Model W2.



Model W4.

- Moving coil and moving iron types.
- Ammeters self contained to 50 amps.
- Above 50 amps DC external shunts supplied and above 50 amps AC external current transformer.
- Voltmeters self contained to 1000 volts in moving coil and to 300 volts in moving iron.

- RF meters supplied with external thermocouples unless otherwise specified.
- Available as DC microammeters, milliammeters, ammeters, voltmeters, AC rectifier type voltmeters, DB, VU, RF, pyrometers, AC milliammeters, ammeters and voltmeters.
- Scale length 3.5 inches. W4, O4.
2.5 inches. W2, O2.

**UNIVERSITY
GRAHAM**
INSTRUMENTS
PTY. LTD.

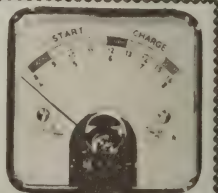
106 BELMORE ROAD, RIVERWOOD, N.S.W.
Telephones: 53-0644 (5 lines)
Telegraphic Address: "Requip," Sydney

STOP PRESS ELECTRONICS AUSTRALIA AUTO VOLTMETER

THREE COLOUR SCALE
State 6 or 12 Volt

PRICE £6/10/-

Plus 12½% Tax. Mounting stand extra.



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W.A.: Atkins (W.A.) Ltd.,
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Box 1478V, G.P.O., Brisbane, Qld.
TAS.: W. P. Martin and Company,
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and 134 Cambridge Street,
Launceston.

AUSTRALIA'S LEADING MANUFACTURER OF ELECTRICAL INSTRUMENTS (A UNIT OF INSTROL)

withstand military environments and will remain completely operational without colour degradation caused by changing magnetic fields, according to Fred W. O'Green, president of the division. Thus, for the first time, full-range colour can be utilised in the display of sensor and computer information in aircraft, ships, submarines, and tanks.

Additional features of the Litton dynamic colour display, called Chromascope, include image storage, true three-dimensional capability in full colour or monochrome, and the capacity for the simultaneous presentation of data from different sources on a single viewing surface.

New Oximeter

Earpiece cells, sensitive to both red and infra-red light, actuate the latest oximeter for measuring the percentage of oxygen saturation in the blood. This model employs modern electronic design to produce the most accurate measurements possible and eliminate the machine's operation from the possible sources of error inherent in oximetry.

Measurements of red light—absorbed in varying degree by fully or partially oxygenated blood—and of infra-red light—which is unaffected by it—can be read as electrical outputs on a meter. The two figures are used to set two sliding cursors on a calculator provided with the unit. A pivoted cursor, adjusted to their point of intersection, then gives an instant reading on a curved scale of percentage oxygen saturation.

The whole process is said to take less than three minutes and to need no mental calculation. (Stanley Cox Ltd., Ellis House, Aintree Road, Perivale, Greenford, Middlesex, England.)

Solar Flares

Prediction of solar flares, which are a radiation hazard to spacecraft and personnel and thus a key to long-duration manned space flight, is a step nearer, according to the Lockheed-California Company. A two-year study conducted by the company—the most intensive ever undertaken of the sun's magnetic fields—has detected patterns of action in solar events such as sun-spots, flares and filaments.

This evidence of an order or system governing solar behaviour is essential to prediction and constitutes a major advance in knowledge. The new evidence, now incorporated in a report, "Research on Solar Magnetic Fields," by Dr Donald S. Webber, head of Lockheed's astronomical sciences laboratory, can be expected to lead to other indicators allowing longer-range warnings.

Moisture in Wool

To provide a rapid method for determining the moisture content of wool, a Direct Reading Regain Tester was designed in the C.S.I.R.O. Division of Textile Physics, Ryde, N.S.W., Australia. It is a robust instrument suitable for use by textile mill employees and gives results accurate to within 1 per cent. Manufacture by National Instrument Company Pty. Ltd., Essendon, Victoria, began in 1962, and about 140 Regain Testers have gone into service, 73 being exported.

The Dryer unit of the Regain Tester was originally designed for intermittent use. Many mills have found it so convenient and accurate that their usage has increased to the point where a continuous-duty dryer has become necessary. A new unit, known as Type 22, designed in the Division of Textile Physics, is now being manufactured by National Instrument Company.

Screw Thread Conferences

Australian industry should rationalise on the ISO inch (unified) and the ISO metric screw thread systems and should declare its existing common thread systems — BSW, BSF and BA — obsolescent. This appeared to be the consensus of opinion in discussion at the two recent conferences called by the Standards Association of Australia to review screw thread standards for Australian industry.

One conference was held in Sydney and the other in Melbourne. They were attended by a total of more than 350 representatives of manufacturers and suppliers of threaded fasteners and associated equipment, Commonwealth and State Government departments, nearly all branches of industry concerned with usage of fasteners and threaded components, and research and professional organisations.

At the conferences, the first paper was presented by Mr L. W. Nickols of the U.K. National Physical Laboratory, who dealt with the development of international screw thread standards, and discussed tolerances and gauging systems and differences between the American and British versions of the Unified screw thread. The second paper was presented by Mr C. A. Gladman of the Australian National Standards Laboratory, who gave a critical review of the SAA publication MP16, "Report on Triangular Screw Threads in Australia," and commented on the effects of a change in screw thread practices.

The proceedings at each conference were summarised by

Mr J. G. Ritchie, vice-chairman of the Council of the Standards Association. Among points made by Mr Ritchie were that the discussion at the conferences had clearly indicated that the Standards Association should provide a suitable range of standards for the ISO thread systems, including thread form, gauges and tools, and for the common types of fastener, that every encouragement should be given by industry and Government to new designs being based on the ISO inch or ISO metric thread forms; that those industries which are at present major BSW users should urgently consider a shift to ISO inch threads; and that manufacturers of fasteners and fasteners' tools should ensure that ISO inch fasteners, particularly UNC, are readily available to users from stock.



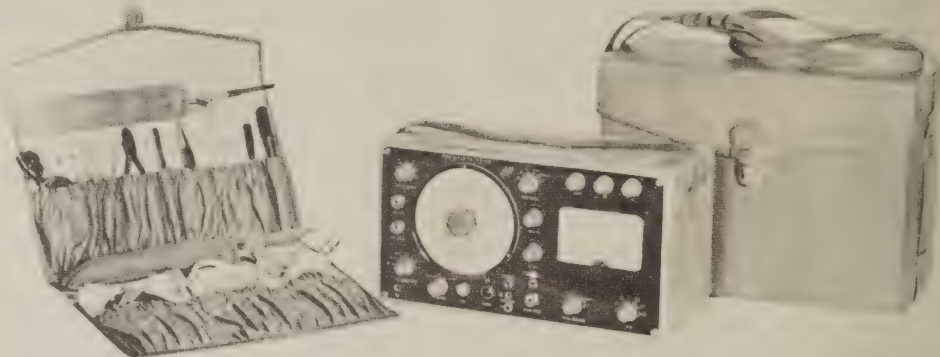
Standard Telephones and Cables Ltd., of Connaught House, London, WC2, have developed this compact, lightweight (32oz) phone, with its 4oz handset. It comes in a variety of two-tone colour schemes, employs dial lighting and emits a call signal produced by a transistor oscillator, the loudness being adjustable to suit the environment. Its electro-acoustic performance has been the subject of careful research and meets world standards for high performance telephone sets.



Pictured above is the new E1,000 Direct Accounting Computer, designed for maximum speed and efficiency in relation to regular accounting procedures. Typical applications include payrolls, job cost and labour distribution, tax and utility billing, inventory control, mortgage, savings and insurance accounting. (Burroughs Ltd., 40 Miller St., North Sydney).

METRIMPEX PORTABLE TV TESTER TR-0809

lightweight - compact - tests every stage



Designed for use with TV receivers the TR-0809 is a compact, light and portable unit which provides test and measurement facilities for every stage and function of a TV receiver. This instrument, which is of high accuracy, is suitable for use in fixed locations—laboratory and service sections—also in the field. It can also be used for servicing radio receivers.

Among the many facilities provided is an inbuilt valve voltmeter which is, itself, an extremely useful instrument apart from its application to TV receiver service. This VTVM has 20 ranges covering DC and AC volts, also resistance.

The TR-0809 is housed in a metal case fitted with a leather carrying handle and finished in hammertone lacquer. A leather carrying case with shoulder strap is also supplied as standard equipment.

SECTIONS INCORPORATED IN THE TR-0809

HF Signal Generator (5.2Mc/s-220Mc/s)

Pattern Generator with sync pulses

FM Inter-carrier Generator (5.5, 6.5Mc/s)

RF Signal Generator (200Kc/s-6Mc/s)

Crystal Oscillator (5Mc/s)

Audio Generator (1000c/s)

Valve Voltmeter	{	DC: 50mV-1000 Volts (7 ranges)
		100V-20KV with probe
		AC: 50mV-300V (6 ranges)
		Resistance: 0.1 ohms—
		1000 Megohms (7 ranges)

Mixer circuit for calibration and measurement.

ACCESSORIES

A comprehensive set of accessories and tools—even a soldering iron—forms part of the equipment. This is stowed in a strong fabric holder which, during transport, is housed in the leather case accommodating the main equipment. This assembly thus makes a complete and convenient set-up for servicing in the field.

Assembled co-axial cable

Measuring Lead

Balancing Transformer

H.T. Probe (up to 20KV)

Ground Clamp

Mains Connector, 6 spare fuses

Leather carrying case with shoulder strap

Operating Instructions

Soldering Iron (24V—plugs into unit)

Set of Tools (Screwdrivers, pliers, etc.)

PRICE £150 F.I.S. all capital cities with all accessories (plus tax @ 12½%)

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469-475 KENT STREET, SYDNEY (26-2651)



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 P.O. BOX 606G
 LAUNCESTON
 (2-5322)

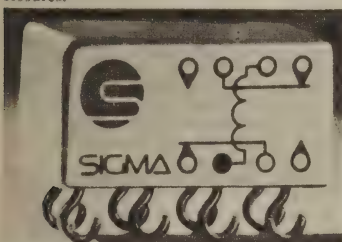
Rayon Strength

The Yokohama Rubber Company, of 9 Shiba-Tamuracho, 5-chome, Minatoku, Tokyo, says it has found a way of raising the strength of spun rayon so that it can be used with greater effectiveness for reinforcing rubber tyres and conveyor belts. Its bond-strength with rubber is also said to be improved.

Treatment is effected at the spinning stage or afterwards by spraying the rayon with one of a number of organic-tin solutions.

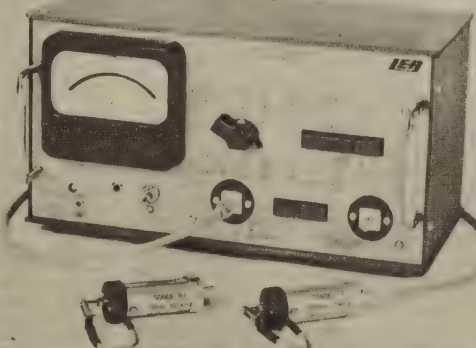
Under Locks — And Key

Daimler-Benz AG., Stuttgart, Unterturkheim, Germany, has patented an all-round locking device for cars. It is operated by several vacuum servo motors connected to a central control located in the driver's door. The driver, on locking his own door, automatically locks all other doors, windows, boot, bonnet and petrol tank cap. Additional mechanisms provide for manual locking and unlocking of individual closures.



Occupying a space of 0.15 cubic inch and weighing 0.35 ounce, this tiny Series 36 relay has characteristics which make it well suited for incorporation in solid state devices, even under onerous physical conditions. (Sigma Instruments, Inc., Braintree, Massachusetts, U.S.A.).

Pictured at right is a new microvoltmeter recently announced by Lea Laboratoire Electro-Acoustique, 5 Rue Jules Parent, Rue il. Malmaison, France. Using solid state circuitry, it has a measurement range of 10uV to 100V, representing a range 142dB. Input is direct or via RF or AF probes, covering a frequency range of 20cps to 10MC. The unit can double as a high-performance pre-amplifier.



Aluminium Protects Zinc

Zinc paints which give cathodic protection to metal for longer than usual are claimed by A. G. Marx, of 6 Taxach, Hallein, Austria. The improvement results, it is said, from combining pure aluminium powder with the zinc in amounts up to 30 per cent, or less depending on the quantity of binder used. Tendency for the paint to blister in hot climates is claimed to be reduced.

Hat, Built-in Radio

Hats with a pocket for a transistor radio receiver permits sports fans to hear one game while they are watching another,

or just to hear the fate of the home team while walking down the street.

The hat, a product of Hat Corporation of America, 530 Fifth Avenue, New York 36, is made of imitation black Persian lamb in "Russian" style. A pocket in the side carries the small radio with a thin wire going to a receiver in the ear. The 20-dollar price includes the radio.

Mechanical Horse

A machine that enables one man to pull loads of up to 18 tons was one of the smaller exhibits among the huge variety on view at the International Engineering Exhibition held recently in London which Denis Desoutter, editor of "Engineering News," picked out for mention in one of his regular industrial reports in the BBC World Service "Science and Industry" program.

"Its makers, M.L. Aviation Limited, call it the Mini-horse," said Desoutter, "and it is simply a three-wheeler tractor, powered by a diesel engine and controlled by a man who leads it like a horse. He has a sort of tiller to steer it by, and on the tiller arm is a squeeze-throttle control. The brakes go on automatically if the conductor should let go. The first use of these Mini-horses is to pull large servicing vehicles to and from airliners at airports, but they will have obvious uses in factories and on farms."

Nitrogen Source

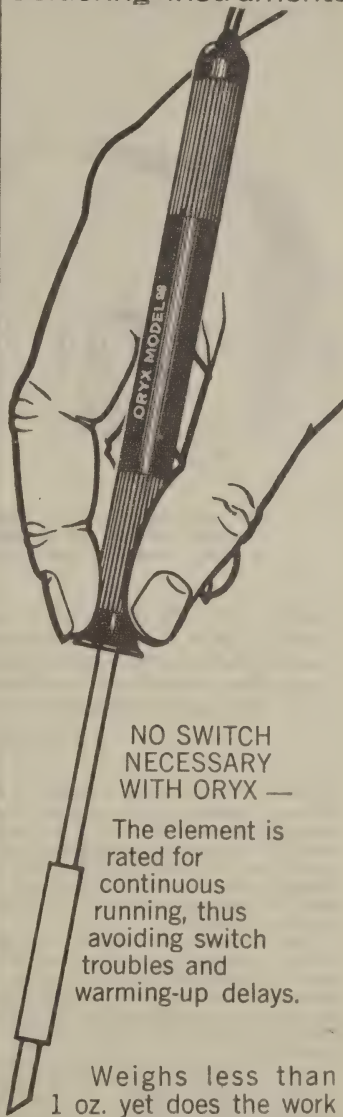
To meet the increasing demand for dependable, low-cost supplies of high-purity nitrogen for numerous chemical, petrochemical, electronic and metallurgical applications, Union Carbide Corporation has developed a new air separation plant cycle for unattended on-site gaseous nitrogen production. Designed to deliver as little as 10,000 and as much as 100,000 cubic feet per hour, the new units yield a continuous supply of high-purity product (99.999 per cent nitrogen plus inerts, with less than 10ppm. of oxygen).

High-purity nitrogen applications have increased rapidly in the past few years as the evolution of new supply techniques has increased the product's availability while reducing its cost.

The units consist of three basic components; the "cold box" package which houses heat exchangers and fractionation equipment, completely factory-assembled and piped; a compressor package consisting of a skid-mounted air compressor, suction filter, snubber, surge tank, after-coolers and complete electric motor control centre; and a liquid nitrogen storage tank which delivers liquid nitrogen during plant shut-down. (Union Carbide International Company, 270 Park Avenue, New York, N.Y., U.S.A.)

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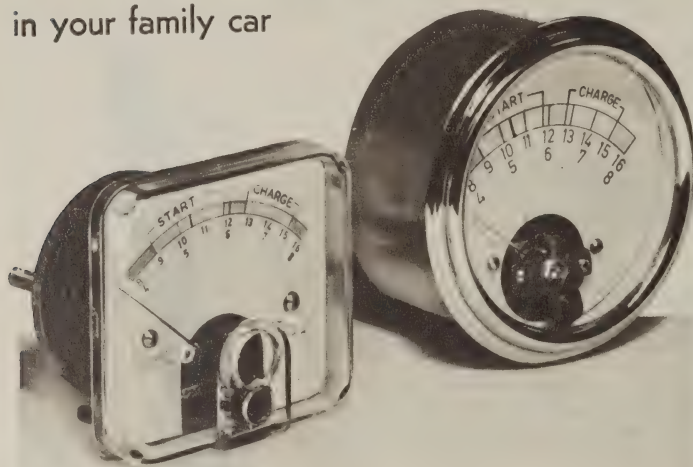
M. 488

27

No more dark secrets when you install a

VOLTMETER

in your family car



Two prototype voltmeters supplied for our preliminary tests by Messrs University Graham and Ferrier Electrical Instruments. Both firms plan to make available instruments styled for use as auto voltmeters.

Back in the early thirties there was some question among car manufacturers as to whether a voltmeter, an ammeter or a simple generator warning light was the most suitable monitor for a car's electrical system. For a time at least one manufacturer fitted voltmeters to his vehicles but the majority settled for an ammeter or a warning light.

By Keith Jeffcoat

SINCE this time the argument has been between the ammeter and the warning light with the idea of an auto-voltmeter almost totally forgotten; forgotten, that is, until recently when a number of auto-voltmeters have begun to find their way on to the American "auto accessory" market.

This renewal of interest overseas caused us to look closely at the value of such a meter and eventually led us to persuade at least two local manufacturers to produce a special unit to be made available for readers of "ELECTRONICS Australia."

At this stage our readers may be wondering why they should need a meter to tell them the voltage of a battery which is nominally fixed at 12 or 6 volts, whichever the case may be.

The fact is that a vehicle's battery voltage will vary quite widely over a range centred around 12 (or 6) volts and an instrument which can show these fluctuations at a glance will reveal quite a lot about the state of the battery and the rest of the electrical system.

To be of any real value, an auto voltmeter must be accurate to within a small fraction of a volt and easily readable — requirements which immediately prejudice its chances of being selected as an item of standard equipment in production cars.

A voltmeter needs to be a much more

refined — and costly — instrument than the average auto ammeter, in which the pointer does little more than deviate from centre, one way or the other, along a sparsely calibrated scale. Yet even the ammeter has been displaced in most vehicles by a simple "no charge" warning light.

Bound up with the question, of course, is the matter of comprehension by the driver. A light which should go out calls for a minimum of mental effort; an ammeter which should read this way or that is rather more mysterious; a voltmeter which calls for definite interpretation presents much larger problem for the uninitiated.

However, readers of this journal are not "uninitiated" and are well able to take advantage of the information which a permanently installed meter can give them about the car's electrical system.

To appreciate how effective an auto voltmeter can be as a monitor, let's review some fundamentals of auto-type lead-acid storage batteries.

The batteries are constituted from a number of "cells," each of which consists, in turn, of a number of "plates" made from a porous lead composition. The cells are filled with a mixture of sulphuric acid and distilled water which is known as the "electrolyte." The specific gravity of water is 1.0 and of sulphuric acid 1.84 and the two are

mixed in the proportions of approximately 2½ parts water to one part sulphuric acid to produce a normal specific gravity of 1.260 at 77 deg. F.

In a fully charged battery the positive plate consists predominantly of lead peroxide, a chocolate-brown coloured substance. The negative plate is of porous lead and light grey in appearance. At this stage the acid is of normal strength, with a specific gravity of 1.26, as previously quoted.

As the battery is discharged, decomposition of the electrolyte takes place until, when fully discharged, each of the plates acquires a liberal coating of lead sulphate. During this process the concentration of the acid electrolyte decreases and the specific gravity is a fairly accurate measure of the state of charge. The specific gravity of the electrolyte in a discharged battery is approximately 1.170.

Although sulphate formation is a perfectly normal part of the discharge cycle, its presence always constitutes a risk. Sulphate has a tendency to harden over a period of time, making it difficult or even impossible for it to return to the electrolyte when we reverse the cycle (charge the battery).

Thus, the further the battery is discharged, the greater is the risk that some of the sulphate will harden if the battery is not immediately recharged. Also, for purely chemical reasons, there is a pronounced tendency for the sulphate to crystallise when the specific gravity falls below a certain figure, representing excessive discharge. Ideally, therefore, a battery should be kept in a fully charged condition as far as possible, fully recharged immediately after discharge, and never excessively discharged.

One method of keeping "tab" on the condition of a battery is to use a device known as a hydrometer, which directly measures the specific gravity of the electrolyte. Unfortunately, however, a hydrometer is a messy thing to use and its readings are subject to some interpretation, because specific gravity will vary with temperature and the different design parameters used by individual battery manufacturers.

We would venture to say that, of those motorists who actually possess hydrometers, very few would make regular use of them to check the condition of the battery.

Quite apart from the specific gravity of the electrolyte, it can be shown that the open circuit voltage is a measure of the state of charge, a fully charged cell measuring about 2.1 volts and a discharged one about 1.75 volts. In fact, it is possible to establish a relationship between open circuit voltage and the specific gravity of the electrolyte.

Thus, an accurate voltmeter may be used as a measure of battery charge and, in fact, a device known as an "electric hydrometer" is now standard equipment in most well-equipped service stations.

This device is nothing more than an expanded scale voltmeter which is designed to be connected across a single battery cell, reading directly the cell voltage and, on an adjacent scale, the equivalent specific gravity figure. (R.T.V. and H. March-April, 1963.)

It is just possible that the eyes of some readers may light up with the

METER READING		MOTOR STOPPED OR IDLING	MOTOR TURNING OVER ON STARTER	MOTOR NORMAL RUNNING (At least twice idling speed)
6-volt system	12-volt system			
Below 4.5 volts	Below 9.0 volts	Battery "flat." Meter leads or fuse open circuited. Meter reverse connected.	Meter defective, disconnected or improperly wired. If the engine will start and/or run, the battery voltage could scarcely be this low.	
4.5 to 5.9 volts	9.0 to 11.8 volts	Battery undercharged or extremely cold. Motor will turn sluggishly and might not start.	Normal range for winter to summer starting.	Generator not charging or voltage regulator faulty. Alternatively, current drain of vehicle's electrical equipment (lights, radio, etc.) exceeds generator output.
5.9 to 6.4 volts	11.8 to 12.8 volts	Battery charged. Varies with temperature, type of battery and degree of charge.	Meter defective. Voltage could not be this high, if starter is actually turning motor over.	Battery fully charged but generator not working or voltage regulator set too low.
6.4 to 7.5 volts	12.8 to 15.0 volts	This high reading is normal for a short period after driving, due to battery "surface charge." If motor has been stopped for some time, however, the meter is defective and reading high.	As above.	Normal range for properly functioning generator and regulator. Exact reading varies with battery charge, engine speed, temperature and regulator setting.
Above 7.5 volts	Above 15.0 volts	Reading too high for surface charge. Meter is probably defective.	As above.	Voltage regulator set too high or contacts sticking. Battery fluid level excessively low.

Set out above are typical voltmeter readings related to normal driving situations. The markings on the meter face, as suggested, summarise this information. Experience will enable the individual to interpret his own readings.

recollection of a high quality DC voltmeter which has been lying, discarded, in their spare parts box. By all means get it out and check it; it could serve you well, even though its lack of expanded scale will make it harder to read while driving.

For those who lack a spare parts box so accommodating, or who want a unit expressly designed for the purpose, we have arranged for the supply of meters to the trade with a suitably expanded scale, marked both with voltage and zones. In addition, the movements have shock-resistant bearings able to withstand vibration, as in a car.

Our voltmeter is not intended to be as pretentious as a commercial electric hydrometer but it will give a quite accurate indication of battery terminal voltage and is therefore most useful in determining the battery charge state. Its major advantage, in this respect, is that it is permanently connected to the battery and its reading is therefore available at a glance. (The drain this meter imposes on the battery is insignificant.)

A fully charged 12-volt battery should show a reading of 12.6 to 12.8 volts and when discharged would read 10.5 volts. Since this range represents approximately 25 per cent of our suggested meter scale, it can be seen that a useful indication of battery state is readily possible.

UNDER LOAD

Incidentally, the figure of 10.5 volts is the figure beyond which further discharge of the battery is likely to cause damage to the plates. Our meter has a red line at the 10.5 volt mark as a warning against over-discharging the battery.

So far we have shown how a meter can determine the condition of a battery under open circuit conditions, i.e., without any form of load connected to the battery. It is also possible to predict an imminent failure of the battery by observing its voltage under operating conditions, particularly when it is being used to power the starting motor.

As a battery ages, its effective plate area may be decreased by sulphating and by loss of active material which

separates from the plate surface and falls to the bottom of the cell container. Both effects tend to increase the internal resistance of the unit. When the battery is then placed under conditions of heavy discharge, as in starting the motor, the internal resistance leads to heating of the cells and hastens their further deterioration.

Under heavy load conditions, this rising internal resistance causes a reduced voltage at the terminals of the battery, which can be easily seen on a voltmeter.

The scale on our instrument has a yellow shaded portion marked "start" and the needle can be expected to drop to somewhere within this range whenever the starter motor is used with the battery in a normally charged condition, as indicated by its no-load voltage.

Once a "normal" value within this range has been established it can be used as a guide to any progressive deterioration of the battery, due to increasing internal resistance.

If, for instance, the battery continues to show an open circuit voltage of 12.6 but the voltage on "start" begins to drop progressively lower each time the starter is used, then it can be taken as a sign of deterioration and the wise motorist would take steps to replace the battery before it strands him on a lonely road some wet night.

The need for a reliable battery is even greater in many modern cars employing automatic transmission, since certain types of automatic transmission will not operate until the engine is running to drive the oil pressure pump. Thus the car cannot be started by towing or coasting; in fact, in no way other than by means of the battery and starter motor.

In use, the voltmeter must be connected directly to the battery posts bypassing, in the process, the normal connectors to the rest of the wiring. There is good purpose in this, because it enables one to distinguish between the internal resistance of the battery and any exces-

sive resistance which may exist in the external wiring cables due to poor terminal connections, loose or corroded joints, or broken strands in the conductors.

Excessive resistance in the cables or terminals would be indicated by a normal reading on the meter coincident with obvious signs of low voltage at the electrical equipment, e.g., starter barely able to turn the motor, lights dim, etc.

Without a voltmeter to tell the full story, the symptoms of excessive cable or terminal resistance would probably be attributed to a flat battery when, in fact, the battery may be perfectly O.K.

It will be noted that the portion of our meter scale between 12.8 and 15 volts is divided off, coloured yellow, and marked "charge." Whenever the motor is running at an r.p.m. figure sufficient to operate the generator cut-off, the pointer should rise to a figure somewhere within this portion of the scale.

HIGH READING

If the car has just completed a run the meter may read within this portion of the scale for a while, even though the motor is not running; this will be due to a "surface charge" on the plates of the battery. Normally the meter will only read within this portion of the scale when the generator is actually charging the battery and, here again, the reading obtained can be an excellent indication of generator performance.

When a motor is first started, and for the first few miles of driving, it would be normal for the meter to read towards the top end of this "charge" scale. During this period the generator and its regulator will be providing an increased voltage and therefore an increased current "charge" into the battery, in order to replace the energy used in starting the vehicle.

As the battery approaches full charge, however, the reading should gradually drop and finally stabilise at somewhere around 14 volts, this latter figure being

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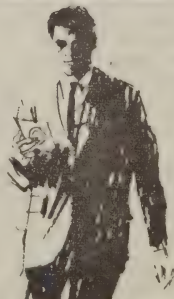
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dependent on the type of regulator used, the manufacturer's settings, and the temperature. Most regulators contain temperature-sensitive elements intended to compensate for the differing charge requirements created by differing battery temperatures.

The actual figure at which the generator voltage should stabilise should be available in the manual for a particular vehicle and this same section of the manual should also list the high and low limits of generator voltage. It is these latter limits that are of most interest to us because a reading outside these limits is an indication of malfunction in the generator/regulator system.

If, for instance, the meter shows a constant "charge" reading toward the high end of the scale, it could mean that the regulator is adjusted for too high a charging rate or, alternatively, that the regulator contacts are stuck together. In either case, the fault must be corrected if damage to the battery and/or the generator is to be avoided.

With very few exceptions, a reading beyond 15.2 volts would be a sure sign of a fault in the regulator and steps should be taken immediately to rectify the same.

On the other hand, readings which are on the low side could mean that the regulator contacts are dirty and need cleaning or that the generator itself has a dirty armature or may even have shorted turns in one of its windings. A low reading could also be caused by a high internal resistance in the wiring between the generator and the battery.

By careful interpretation, an ammeter may reveal some of the troubles enumerated, but a generator warning light, or "idiot light," as it is sometimes called, tells nothing more than the fact that the generator output exceeds some pre-set minimum value. However, neither ammeter nor light can reveal as much about battery or electrical system condition as the voltmeter is capable of showing.

SPECIAL MOVEMENT

The majority of auto voltmeters currently available on the American accessory market are of the moving iron type and calibrated to read from 0 to 16 volts at full scale. These meters have the advantage of being cheap and fairly robust in construction and, in addition, their movements are non-linear, so that particularly the bottom portion of the scale is cramped, with the centre section well spread out. For the present requirement, this is an advantage, because most of the measurements involve the centre portion of the scale.

Unfortunately, these meters do not have the order of accuracy we felt was really desirable—approximately 2% to 3% at full-scale deflection—and we accordingly turned to the idea of using a moving coil meter, preferably with some form of expanded scale, either mechanical or electrical.

Another requirement for any meter intended for mounting in a car is that it be sufficiently robust to withstand the vibration which is normal to this environment. This generally means that the meter should be specially made for the job.

The idea of using an electrically expanded scale meter occupied our thoughts for some time, but this type of instrument has the disadvantage in being difficult to calibrate unless a known accurate source of voltage is available.

There is the further disadvantage that an electrically expanded type of meter costs rather more and is scarcely warranted unless expansion of 30% or less of the normal scale is required. For the present purpose, we felt it sufficient to expand 50% of the normal scale and we found that the cheapest and most satisfactory way of doing this was to use a type of expanded scale meter which local manufacturers could supply as a standard line.

To further simplify matters for the

This sample "log" was prepared by averaging the readings taken on two vehicles of widely different make and age. The readings, in most cases, agreed within .2 of a volt. It is interesting to note that the first

and last readings, even allowing for a cold battery, are somewhat below normal for a fully charged battery and they emphasise a condition which, without the meter, may not have been immediately noticed in either vehicle. Both vehicles had been used only for short daily runs and the generator had not been able to replace the energy used in starting, etc. The use of an auxiliary charger seems called for.

home constructor, they can also supply a suitable scale, made to our specifications, so that there are virtually no calibration problems.

Although we have, to this point, spoken of these meters as "expanded scale" units, the correct term for them is really "suppressed zero movements," for that is exactly what they are.

They are a normal movement, but their hairsprings are "wound on," so that the pointer is forced back against the stop to the extent that half the intended FSD current flow is necessary to overcome the pre-tensioning of the spring.

In "winding on" the hairsprings the manufacturer actually halves the normal sensitivity of his movement or, in other words, doubles the amount of current required to achieve full-scale deflection.

In a typical case a 0.1 milliamp movement which has been 50 per cent zero suppressed would now require 1 milliamp of current flow to overcome the pre-tensioning of the springs and move the pointer from the stop up to the zero mark on the scale. The next 1 milliamp of current flow would move the pointer

Preliminary reading (cold battery)	11.9 volts
Ignition switched on	11.7 volts
Press starter button	10.0 volts
Drive for 5 miles	14.1 volts
Stop vehicle (battery "surface" charged)	12.9 volts
Ignition switched on	12.4 volts
Press starter button	10.5 volts
Drive 40 mins	14.1 dropping to 13.8 volts
Stop vehicle (surface charge)	13.0 volts
Vehicle standing (overnight)	12.1 volts

from the zero to the full-scale mark.

Of the two local meters which have been made available for this project, one is a 2-milliamp full-scale deflection movement with a sensitivity of 500 ohms per volt. The other meter requires 10 milliamps for full-scale deflection and its sensitivity is 100 ohms per volt. The extra current drawn by the second movement is of no consequence despite the fact that it will be permanently connected across the car battery. If the vehicle were left in the garage and never used the meter would take almost 12 months to flatten the battery.

Multiplier resistors for either movement can be calculated in the normal manner although, of course, the meters will not begin to read until half the full scale deflection voltage is reached.

In the case of the meters mentioned, the scales are calibrated to read from 4 to 8 volts for a 6-volt vehicle and from 8 to 16 volts for a 12-volt vehicle. In both of the meters supplied by local manufacturers the appropriate value of multiplier resistance will be included but the user must specify whether the

(Continued on Page 75.)

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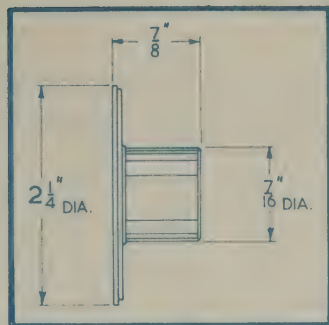
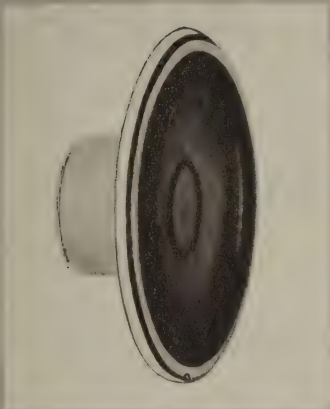
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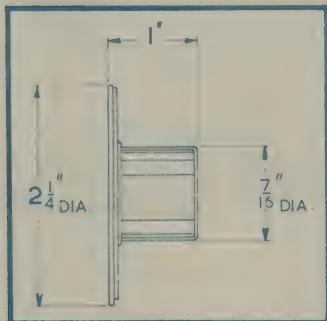


SPECIFICATION

RESONANCE: 350 cycles
 RESPONSE: 300-4,000
 VOICE COIL IMPEDANCE: 8 ohm
 POWER HANDLING ABILITY (PEAK): 250 mw
 TOTAL GAP FLUX: 9,000
 AIR GAP FLUX DENSITY: 6,000
 RAFFLE OPENING: 2" round
 MOUNTING HOLE CENTRES: -
 MAXIMUM DEPTH: 7/8"

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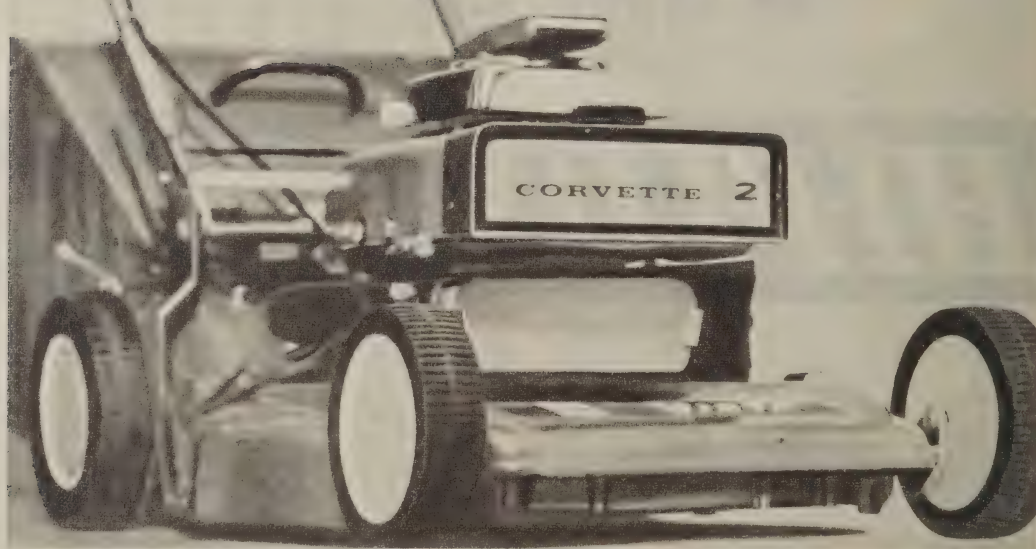


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AIR GAP FLUX DENSITY:	7,000
RAFFLE OPENING:	2" round
MOUNTING HOLE CENTRES:	-
MAXIMUM DEPTH:	1"

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STANDARD "AUDIO" OSCILLOSCOPE

In this article, we describe the construction of a 3-inch oscilloscope, designed primarily for audio and other limited frequency applications and for general use around the "Ham" shack. Avoiding the complications and cost of our earlier 3-inch wide-band oscilloscope, it should also make an excellent tuitional project for construction and use by radio club members.

By Keith Woodward

THE gentleman who coined the phrase "seeing is believing" could not have coined one more appropriate to the cathode-ray oscilloscope—or "CRO."

Frequently, in connection with electronic circuits, observation suggests the presence of signals or other voltage phenomena, though their exact nature may not be too clear. In most cases, an oscilloscope can exhibit the signal or voltage visually, allowing it to be examined and evaluated with a minimum of ambiguity.

Seeing is, indeed, believing!

The uses which a CRO can be put to are legion, depending on the functional design of the instrument. Oscilloscopes vary from relatively simple designs, with restricted frequency range, to instruments with bandwidths from DC to 10MC or more. While extensive facilities are extremely useful in laboratories and other specialised fields, the simpler forms of cathode-ray oscilloscope can perform most of the tasks required in the classroom, the home workshop and the "Ham" shack.

In connection with audio amplifiers, oscilloscopes are commonly used to evaluate frequency response, observe overload distortion and any tendency to supersonic oscillation, and to display the ripple on the HT line or the presence of hum in the output.

Other "audio" applications include the use of Lissajous figures for frequency comparison and use of the instrument as a high impedance AC voltmeter. A CRO will also very usefully display the amplitude and waveform of the high frequency bias signal in tape recorders.

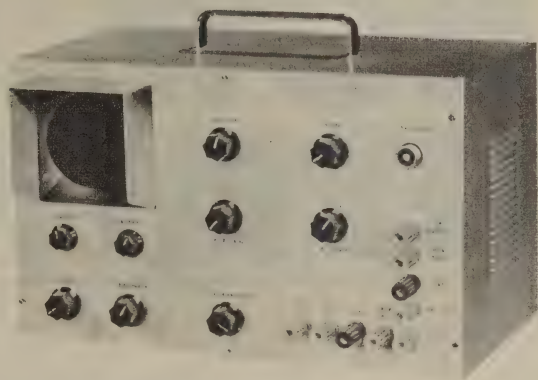
The use of a modest oscilloscope is not limited to audio amplifiers but extends to many other applications. In using a wheatstone bridge, a cathode-ray oscilloscope can make a very sensitive null indicator. In TV receivers it may be used in alignment procedures, as well as checking the audio section.

If provision is made for access to the

oscilloscope deflection plates, further applications are possible in the field of transmitting monitoring.

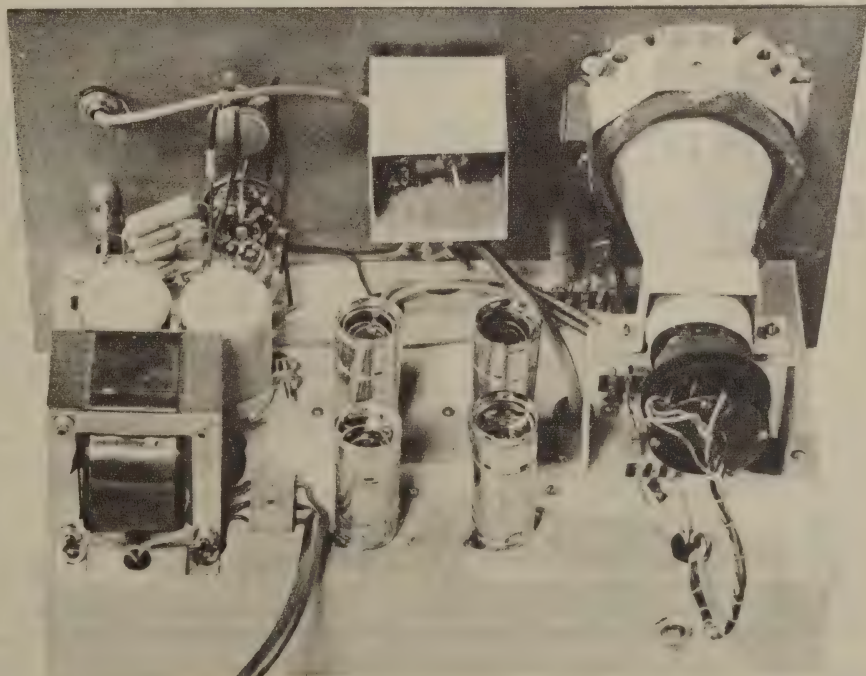
Thus, while most of us would like to own an oscilloscope with elaborate features and specifications, a much simpler—and cheaper—instrument is not to be despised. This is the very reason why the present one has been featured, taking the place of older designs which, in most cases, depend on components no longer available or necessary.

When building an oscilloscope the classic question crops up as to whether a cathode-ray tube of the "surplus" variety should be used. Due consideration was given to this point and for various reasons, including availability, age and size, it was decided that the best approach was to use a new cathode-



All controls on the front panel of the oscilloscope are well spaced to permit adjustment without fumbling. The terminals used allow banana plugs or spade lugs to be utilised on test leads.

The pre-set astigmatism control may be seen on the rear of the chassis in this photograph. Note that the deflector plate leads are not incorporated in the laced form leading to the CRT socket.



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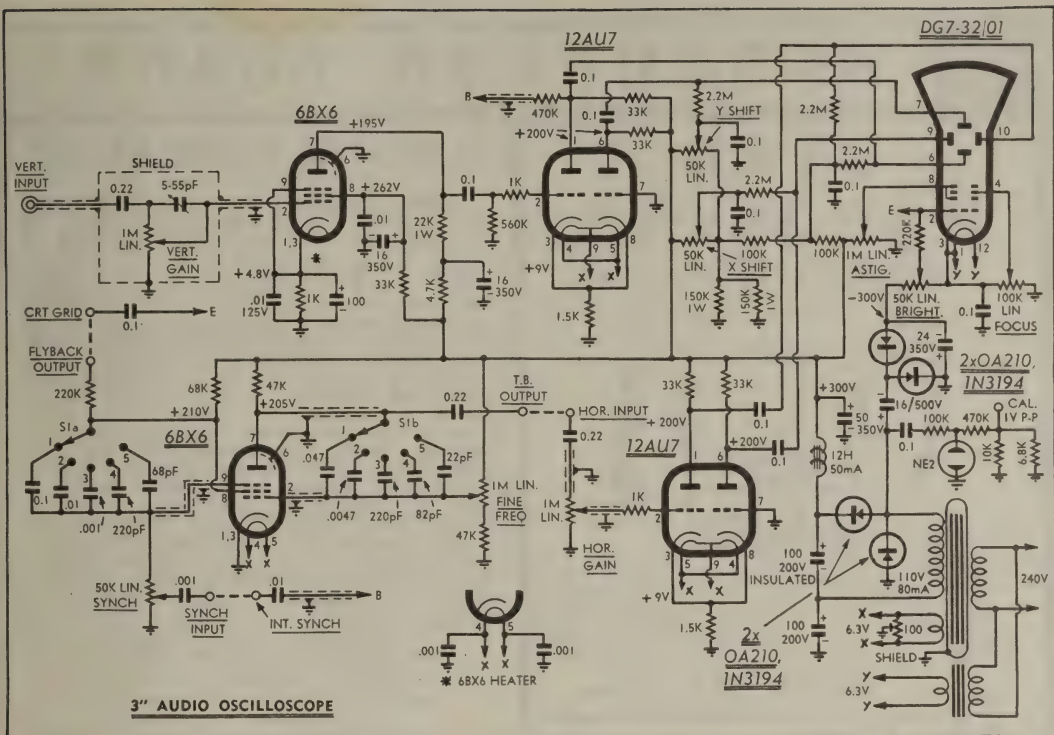
to the diaphragm unit, have given the New **C8MX** even better Transient Response, Acoustic Efficiency and Power-handling Capacity — it is now rated at 16 Watts Peak — than the **8MX**.

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3" AUDIO OSCILLOSCOPE

ray tube. The instrument has therefore been designed with the characteristics of a particular tube in mind; it is not suitable for use with "surplus" tubes, requiring higher supply and signal drive voltages and, in most cases, a different physical layout.

Our selection was a DG7-32/01 cathode-ray tube, which has the immediate advantage of small physical dimensions. These dimensions allow the use of our standard instrument case, 13 x 8 x 7 inches, which is not unduly expensive as metalwork goes. If the instrument is to be used at more than one location, a suitable handle from the local hardware store makes it into a readily portable instrument.

As the power supply is an integral part of the design and in close proximity to the CRT, the correct power transformer must be chosen. The power transformer used in our prototype is a "low radiation" type, as used in tape recorders, fitted with an external copper band to reduce the external magnetic field.

A second transformer to operate the heater of the CR tube which runs at about 300 volts below chassis potential. Being small and mounted well away from the tube, a normal 6.3V filament transformer was used.

Because of the relatively high cost of a commercial mu-metal shield for the CRT we also laid out our chassis for minimum coupling between the CRT and the two transformers, in the hope that no shield would be required. However, a small trace of magnetic field interference was present evidenced by a slight modulation of the trace. As the effect was so small, it was reasoned that a simple shield of tin-plate might suffice to clear the trouble. This proved to be the case and the tin-plate shield, as pic-

We have endeavoured to keep the above circuit simple without prejudicing the performance. The typical voltage readings shown were made with a VTVM and would vary if taken with a multimeter of lower sensitivity.

PARTS LIST

- 1 Instrument case, 13 x 8 x 7 inches complete with front panel and chassis.
- 1 Power transformer, low radiation type, 240VAC primary to 110V at 80mA DC and 6.3V at 2.4A.
- 1 Heater transformer, 6.3V at 1A.
- 1 12H, 50mA filter choke.
- 4 9-pin ceramic valve sockets with shields.
- 1 2-pole, 5-position wafer switch.
- 9 Screw/banana plug terminals, 7 red and 2 black.
- 1 Shielded input connector and plug.
- 7 Knobs, approx. 15/16in diameter, with position line.
- 2 Knobs, approx. 3/4in diameter, with position line.
- 1 Set cathode-ray tube mountings including hood.
- 1 Green graticule for cathode-ray tube (optional).
- 3 2-lug tagstrips.
- 5 3-lug tagstrips.
- 4 4-lug tagstrips.
- 5 6-lug tagstrips.
- 4 7-lug tagstrips.
- 1 3-section double connector for power cord.
- 1 length 3-core power flex.
- 1 NE-2 neon.

VALVES AND DIODES

- 2 68X6 valves.
- 2 12AU7A valves.
- 1 DG7-32/01 cathode ray tube complete with socket.
- 4 IN3194 diodes or equivalents.

RESISTORS

($\frac{1}{2}$ -watt unless otherwise specified)

- 3 1K.
- 2 1.5K
- 1 4.7K
- 1 6.8K (see text)
- 1 10K (see text)
- 1 22K 1W
- 5 33K
- 2 47K
- 1 68K
- 3 100K
- 4 50K linear potentiometers
- 1 100K linear potentiometer
- 4 1M linear potentiometer

CAPACITORS

- 1 22pF ceramic NPO 400VW.
- 1 68pF 400VW plastic.
- 1 82pF 400VW plastic.
- 2 220 pF 400VW plastic.
- 2 100pF 400VW plastic.
- 1 .0047uF 400VW plastic.
- 4 .01uF 400VW plastic.
- 1 0.47uF 400VW plastic.
- 12 .1uF 400VW plastic.
- 3 .22uF 400VW plastic.
- 2 16uF 350VW pigtail electrolytics.
- 1 16uF 500VW pigtail electrolytic.
- 1 24uF 350VW pigtail electrolytic.
- 1 50uF 350VW pigtail electrolytic.
- 2 100uF 200VW insulated upright mounted electrolytics.
- 1 5-55pF trimmer.

MISCELLANEOUS

Screws, nuts, solder lugs, hook-up wire, tinned copper wire, shielded wire, solder, etc.



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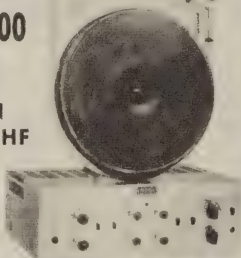
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Frequencies	adjustable.
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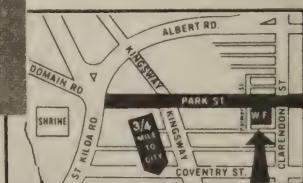
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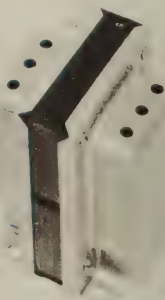
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OPM19A	5	7000,5000	S.E.	500,250,166,100
OPM20A	5	10000,8000	S.E.	15,8,3,7,2
OPM2A	7	10000	P.P.	15,8,3,7,2
OPM15A	10	10000,7000,5000 2500	P.P. or S.E.	3,7
OPM3A	10	4000,2500	S.E.	15,8,3,7,2
OPM4A	10	4000,2500	S.E.	500,250,166,100
OPM16A	10	500		15,8,3,7,2
OPM5A	15	5000,3000	P.P.	15,8,3,7,2
OPM6A	15	5000,3000	P.P.	500,250,166,100
OPM7A	15	(10000),8000,7000	P.P.	15,8,3,7,2
OPM8A	15	(10000),8000,7000	P.P.	500,250,166,100
OPM17A	15	500		15,8,3,7,2
OPM10A	25	8000,6600	P.P.	15,8,3,7,2
OPM9A	25	8000,6600	P.P.	500,250,166,100
OPM18A	25	500		15,8,3,7,2
OPM14A	35	8000,6600	P.P.	15,8,3,7,2
OPM11A	35	8000,6600	P.P.	500,250,166,100
OPM13A	55	3500	P.P.	15,8,3,7,2
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() Impedances in brackets indicate screen taps available.

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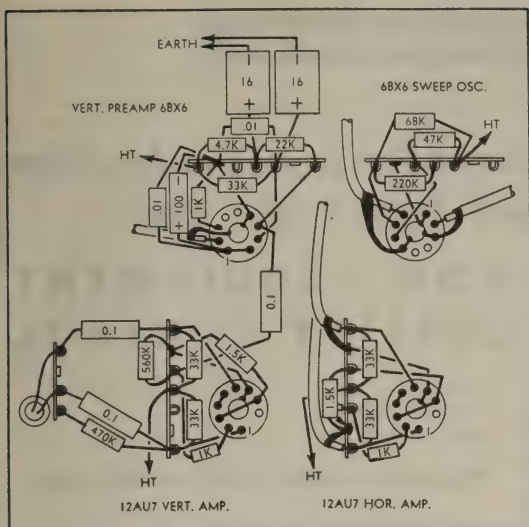
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Above is a partial wiring diagram of the sweep oscillator vertical pre-amplifier, vertical amplifier and horizontal amplifier. Only the more important components and wiring runs are shown for clarity. The filament wiring, not shown, should be run in twisted lead.

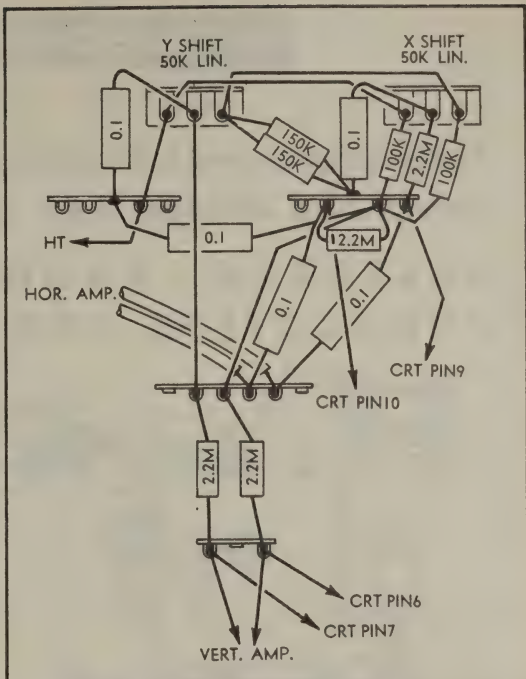
the spot will be made brighter or fainter, as the case may be. Used in this way the brightness modulation can indicate a time sense or difference and may operate to suppress an unnecessary or confusing portion of the trace.

When constructing any oscilloscope one trouble which is likely to be encountered is the horizontal timebase signal radiating into the vertical amplifier. With the layout used in this oscilloscope two distinct precautions were required to prevent this happening. One, which will be apparent in the accompanying photographs, is the provision of a shield around the Vertical Gain control and associated components. The other precaution is the use of two .001 disc ceramics at the 68X6 vertical pre-amplifier socket bypassing each filament pin to chassis.

The shield can be folded from tinplate in the form of a 2-inch cube, but minus one side. The potentiometer can be mounted inside it and the components installed and pre-wired, including two lengths of shielded lead. The assembly can then be attached to the front panel by a second nut on the pot shaft.

To secure maximum frequency response from the vertical amplifier, care must be taken with the layout of the associated components. The wiring diagrams supplied show most of the relevant details. The wires to the CRT socket should be kept to a minimum length and the coupling capacitors from the 12AU7A plates should be suspended above the chassis, not touching the chassis. These simple steps are all aimed at minimising shunt capacitance. In this regard, also, the 470K resistor associated with the sync. circuit should be connected directly to the 12AU7A circuit and the other end routed via shielded cable, to the appropriate terminal.

If an audio generator is available, with a flat frequency response output to above 100KC, it may temporarily be fed to the grid, pin 2, of the 12AU7A and the frequency response of the amplifier



The wiring of the two shift controls is shown above. The wires to pins 6, 7, 9 and 10 of the CRT socket should be kept short as possible to minimise any high frequency losses, due to capacitance to chassis. By suspending components on tagstrips underneath the cathode ray tube we were able to make use of space which normally would be wasted.

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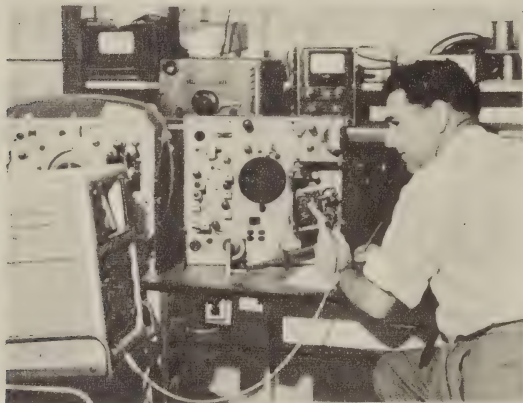
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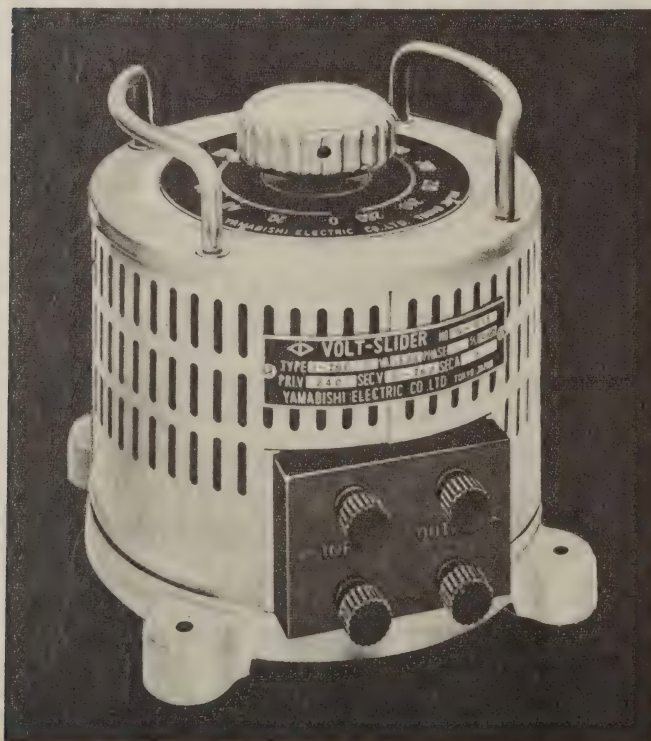
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checked. Should the generator have low impedance output, generally the case, a series resistor of approximately 47K should be inserted between the generator output and the grid for this test, to simulate the source impedance from which it will ultimately be fed. In our prototype response extended from 18cps (the lowest frequency we could measure) to 3dB down at 175KC.

Passing to the vertical pre-amplifier circuit, it will be noted that an electrolytic capacitor is used as a second bypass on the screen-grid. This improves the low frequency response of the amplifier while the .01 bypass capacitor takes care of the higher frequencies. Similarly the cathode is heavily bypassed by a 100uF capacitor. Lower values of capacitance should not be used, otherwise the low frequency response will suffer.

The relatively low value plate load specified for the 6BX6 serves to ensure a sustained high frequency response, though at the expense of gain at all other frequencies. This is the normal compromise that must be made in such circumstances.

FREQUENCY RESPONSE

At this stage, with the vertical gain control full on, the audio generator may be fed into the vertical input and the frequency response again checked over the complete system. The response should again read 3dB down at approximately 175KC.

Without the trimmer shown in the circuit, it will be found that, as the gain control is turned down, the high frequency response will be adversely affected.

The function of the trimmer is to compensate for this deficiency. To set the trimmer at its optimum value, the vertical gain control should be set at its electrical mid-scale. As this is a linear potentiometer this should coincide with the mechanical mid-scale. Now try various settings of the trimmer and for each setting sweep the audio generator up to 100KC. The setting which gives a flat response to this frequency is the correct one. In our prototype we ended up with approximately 22pF in the trimmer.

While conducting these frequency response measurements we removed the link on the TB Output/Hor. Input terminals. This leaves a vertical line on the oscilloscope screen which is easier to check than a swept pattern.

The time-base oscillator has five switched positions giving a frequency range from a few cycles per second to approximately 50KC. It has been indicated both in the circuit and the wiring diagrams which leads from this oscillator are wired in low-capacitance shielded cable. This precaution is necessary to stop radiation into the vertical amplifiers. We found that the oscillator synchronised quite well with the signal available from the 12AU7A plate.

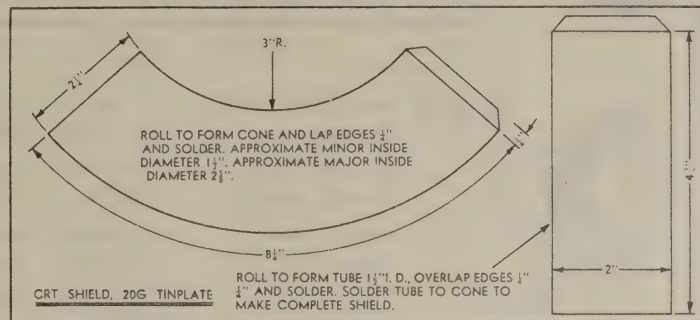
An earlier attempt to take the synchronising signal from the pre-amplifier plate was a failure, as the time-base frequency was fed into the vertical amplifier in sufficient quantity to be quite noticeable in vertical deflection on the screen. However, this quantity of time-base signal has no effect when connected directly into the deflection plate circuits.

While the linearity of the time-base could no doubt be improved by the use of a cathode follower feed-back system, the linearity of our oscillator was

quite good enough for the applications envisaged. The time-base oscillator feeds into a long-tailed pair phase inverter/amplifier which drives the horizontal deflection plates. As the frequency response is not quite so critical, at least for the sweep frequencies most used, we were able to use shielded lead on the 12AU7A plates to reduce the possibility of radiation into the vertical amplifiers.

To provide suitable operating voltages

A pattern for the CRT shield is given on our chassis blueprint but the general shape is as sketched. Made of tin-plate, the shield is reasonably easy to manufacture. After the cone is cut out, it may be formed by working it around a smooth piece of pipe held firmly in a vice. By gradually breaking the grain of the metal a crinkle-free cone may be formed. Tin the sections of the overlap joint before clamping it together with a small G-clamp. A hot soldering iron



A simple diagram showing the construction of a tin-plate shield for the cathode-ray tube. Full details of this and other metalwork are given in the blueprint which is available through the query service.

for the cathode-ray tube, two rectifying systems are used from the power transformer. The first is a standard voltage doubler system, producing a positive high tension voltage for the amplifiers and time-base, as well as for the deflector plates and screen of the CRT. The second voltage doubler rectifier, capacitance coupled to the secondary of the power transformer, has a negative output and is used to feed the cathode, control grid and plates one and three of the CRT.

Spot focusing will tend to vary over the cathode-ray tube screen if the final accelerating electrode or "anode" is not at a potential equal to the average potential of the deflection plates. This effect is termed "astigmatism," as the defocusing effect resembles that experienced by people with astigmatic vision.

To allow astigmatism to be minimised, the final anode voltage is supplied by a pre-set potentiometer connected between the positive high tension line and the chassis. This potentiometer is located on the rear apron of the chassis. The setting will depend somewhat on the normal operating point of the brightness and focus controls. For normal operation, once the control has been set, it need not be altered.

The maximum heater-to-cathode voltage for the DG7-32/01 is quoted as 125 volts. This meant that we could not use the same heater supply as used for the amplifiers and time-base, since this heater supply is returned to ground. To overcome the problem, a separate heater supply is used and the cathode is connected to one side of this supply.

When fitting the coaxial-type connector for the vertical amplifier input, take care to insulate it from the front panel. The shielded lead from the connector is earthed at the vertical gain control. At this point the gain control and shielding box are also earthed to the panel. We found that this arrangement gave the least trouble from ground loops in the input circuit.

may then be applied to run the solder together and make a permanent joint.

The cylindrical section of the shield is similarly fashioned and butt-jointed to the conical section. The completed shield should be a snug fit over the CRT, leaving a portion of about 5/16 inch from the face of the CRT free from shielding. A coat of enamel will help protect the shield from rust.

If it is preferred, the manufacturer of the CRT (Mullard) is able to supply a mu-metal shield for this particular tube. However, while far more effective as a shield, the commercial unit is not cheap.

MOUNTING CRT

When mounting the CRT on the chassis, a length of foam plastic packing should be wrapped around the face end to hold it securely in the mounting plate.

A "U" shaped clamp on the neck of the CRT holds it firmly in place against the front mounting plate. Before tightening the "U" clamp the cathode ray tube should be oriented correctly using the horizontal sweep trace.

While metalwork for this project will probably be available from some of our advertisers blueprints (2) will be available through our query service for those who like to "roll their own."

The "Calibrate" terminal used on the oscilloscope supplies a clipped (square) wave of 1 volt peak-to-peak. It is necessary to vary the value of the resistance from the "Calibrate" terminal to ground to achieve the correct output. This may be done by checking the output with an oscilloscope of known calibration. If an oscilloscope is not available it can be checked with a VTVM. The VTVM should give a reading close to 0.49 volts RMS corresponding to 1V P-P for the waveform concerned.

We found on the prototype that a parallel combination of 10K and 6.8K gave the correct output, but this may vary from oscilloscope to oscilloscope.



TRUMPETS



H 210

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Sound distribution	90°	Watts peak	25 watts
Air column length	510 mms.	Voice coil impedance	16 ohms
Maximum diameter	225 mms.	Frequency response	150-6,500 Hz
Maximum length	275 mms.	Maximum diameter	82 mms.
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		Weight	790 grs.
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H 300

Low frequency cut-off	220 Hz	Watts peak	35 watts
Sound distribution	90°	Voice coil impedance	16 ohms
Air column length	550 mms.	Frequency response	120-7,000 Hz
Maximum diameter	315 mms.	Maximum diameter	82 mms.
Maximum length	365 mms.	Maximum height	68 mms.
Weight	1,500 kgs.	Weight	1020 grs.
Power rating	18 watts	Complete with accessories for application of line transformer.	



H 800/s

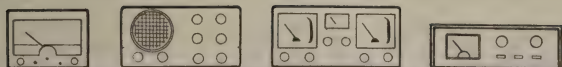
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Power rating	25 watts	Price on application.	
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Voice coil impedance	16 ohms		



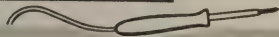
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THE CUSTOMER IS ALWAYS RIGHT

This well-born business slogan has served as a basis for dealer/customer relations ever since man first began to sell produce in a market place, and there is undoubtedly something to be said for it. Nevertheless, there are times when not only is the customer wrong, but he must be shown he is wrong if the serviceman is to retain his reputation. Such a situation calls for diplomacy of the highest order.

THE story I am about to relate is a typical case; one where the customer was convinced he had been "done" and was determined to make the point, and where I was equally determined that I was going to vindicate myself at any cost.

Frankly, I feel there is a limit to the amount of self-effacement in which a serviceman should indulge, particularly where his competence or integrity has been questioned. Certainly it may appear easier and more diplomatic to put right whatever is wrong, without argument and possibly without charge, on the basis that it is not worthwhile antagonising a good customer for the sake of the few shillings involved.

But I wonder!

Such a procedure amounts to a tacit admission of guilt. The customer is now quite SURE that you were wrong and that it was only his own astuteness which prevented him from being "taken." Even if he continues as your customer, it will most likely be without any real confidence. And his friends will undoubtedly hear his version of the story.

"If you have any dealing with So-and-So, watch him. He tried to put one over me until I tackled him about it. Then he just looked sheepish and did the job properly without another word. All right if it comes off, of course, but I was too smart for him."

And that is the kind of publicity we can all do without. All our "diplomacy" has done is keep a customer but lose his confidence; which could well mean losing several new customers as well.

FACE UP TO IT

It is far better, I feel, to face up to accusations fairly and squarely. If you have made an honest mistake, then admit it, and put right whatever is needed. But if the fault is not yours, then let this be just as clearly understood.

As for the risk of antagonising the customer, this is a fear that I feel is very much overdone. For one thing, it is better to risk this kind of antagonism — which probably will be short lived if the customer knows in his own heart that you were right — than the previous kind where the customer is sure HE is right.

In any case, convincing a customer that he has made a mistake — almost certainly an honest one — need not necessarily antagonise him. In fact, this

is real "diplomacy"; the ability to convince the customer that you are right, that he made a mistake, but that the mistake is an understandable one. Explain how it happened if possible, thus leaving him an "out" whereby he can withdraw without too much loss of dignity.

In this case the customer was a valued one of long standing. I had helped install their TV set — the subject of the present discussion — over five years ago, had serviced it ever since, and had benefited from a number of other transactions from the same household. And, while all my dealings with them had been on a strictly business basis, it was inevitable that I had come to know them pretty well. Certainly I valued them as customers; but I valued their respect of my ability and integrity just as much.

SUSPICIOUS TYPE

On the other hand, I had always had the feeling that the man of the family never really trusted me or, at any rate, that he distrusted servicemen in general. Perhaps I couldn't blame him for that, but I did feel that he should treat me, or any other serviceman, on my merits.

The circumstances which led to the final showdown started in October of last year — the date is important — when he complained that the TV picture was getting weaker. Apparently it had reached a stage where it could no longer be used during the day and only in a dimly lit room at night. I packed a suitable replacement picture tube and went out to have a look at it.

Sure, enough, the picture tube had "had it"; which wasn't surprising in view of its age. Happily, the customer accepted the diagnosis quite philosophically, expressed the view that it didn't owe him much, and asked how much it would cost to fit a new one. When I told him he raised the point as to whether he should fit a new tube or trade in on a new set, adding that he did not want to incur any more expense at the moment than he had to.

Since the set was still reasonably modern, and he obviously was inclined to keep it, I said I thought it would be quite worthwhile to fit a new tube. Apart from minor problems, the set should give many years more service.

He quickly made up his mind to do

this and I replaced the tube on the spot. At the same time I checked the set for any other obvious defects, touched up the height and linearity controls, and generally made sure that everything was working properly before I left.

And that was the last I heard of the set until a few weeks ago. Then the owner called and complained that the set was not performing very well. When I tried to find out more precisely what was wrong, he was rather vague. He talked about a "weak" picture, "speckles" (snow) and black bars across the screen, then finally came to the point.

"The truth is," he said, "It's never been any good since you put that new picture tube in. I was very disappointed with the whole transaction."

DELAYED COMPLAINT

I must confess that this rocked me somewhat. I felt inclined to ask why, if he had been so dissatisfied, had he waited so long to complain about it. But there was no point in starting an argument at this stage, so I simply replied that I was very sorry to hear it and that I would try to get out and have a look at the set that evening.

When I arrived he greeted me quite cordially, and apologised for keeping me out so late, while his wife offered me a cup of tea. Diplomatically, I accepted the latter, and this seemed to ease the tension a little.

Nevertheless, when we came to look at the set, he was still quite adamant that it had never been any good since the new tube had been fitted. I said nothing, but simply switched the set on and waited for it to warm up. When it did, I had to admit that its performance was poor. Channel 2 was virtually non-existent, while Channels 7, 9 and 10 were washed out and snowy. In addition, 7 and 9 had a beautiful "windscreen wiper" effect. (Horizontal blanking bar from another channel drifting across the screen.)

The weak, snowy signals suggested a tuner fault, probably a sick RF valve. I pulled the set out from the wall, intending to check this, when something caught my eye. I turned to the owner.

"How long," I asked, "Have you been running the set without an aerial?" "What?" he replied, with obvious incredulity.

I pointed to the floor behind the set, where the feeder lay untermated on the carpet. Both he and his wife stared at it in obvious surprise, looked at each other, then back at me.

"Is that all that's wrong with it?" the husband asked at last, probably because it was all he could think of to say.

"No," I replied, "It may not be all but it is one very good reason. Any idea how it happened?"

The husband looked sheepish.

"We sometimes pull the set out from the wall to make for more convenient seating. I suppose we must have pulled it too far."

While we had been talking I had stripped the ends of the feeder and replaced them under the chassis terminals.

After resetting the brightness and contrast controls, the set gave a near perfect picture. The only snag was the windscreen wiper bar which was still evident. This was obviously due to channel 10,



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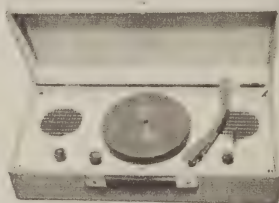
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Hum and noise
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which had caused a lot of similar problems in this area.

The husband picked this point immediately, probably to cover up his embarrassment over the aerial.

"It's that bar that really bothers me," he explained. "And that's been there since you put the new tube in."

"Since last October?" I asked.

"Yes," he replied, and his wife backed him up.

"Are you sure it hasn't been only since last April?" I asked. But both were adamant that it had been there since last October.

"In that case," I replied, half jokingly, "I'm afraid there is nothing I can do about it."

Naturally, they both expressed surprise and wanted to know why.

"Well," I explained in mock seriousness, "the only cause that I know of for that complaint is interference from channel 10. But if it started last October it can't be channel 10 because they didn't start transmissions before April. Therefore it must be a completely new fault that I know nothing about."

Perhaps it was a brutal way to prove my point, and I might not have tried in other circumstances, but I had judged their reaction pretty accurately. The husband looked a bit sheepish and then grinned.

"Well, perhaps you're right," he said, "It's hard to keep track of when these things happen. It just seems that the set's been playing up for a long time."

I agreed that it was difficult to be sure about these things, and went on to explain that other customers were often confused in this manner. This last was aimed at taking some of the sting out of my victory.

After that, the problem of the wind-screen wiper bars was something of an anti-climax. Some adjustment of the AGC control, plus a small pad in the aerial feeder cured it completely. For the first time in many months the set was delivering a first-class picture.

We parted on the most cordial terms, and I am quite sure that I lost nothing by standing my ground and refusing to be browbeaten into taking the blame for something I hadn't done. In fact, I suspect that I may actually have boosted his confidence in my integrity.

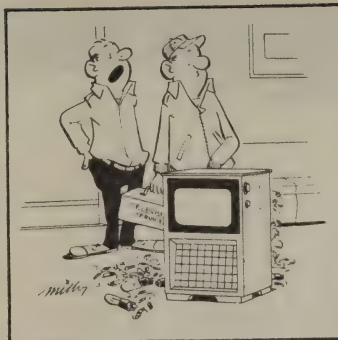
Be that as it may, the story itself provides a classic example of how customer confusion, combined with natural suspicion, can lead to a serviceman being falsely accused of incompetence or malpractice.

The truth is, people DO lose track of when things happen, and it DOES seem (to them) that the set has been playing up for a long time. It needs only one more step in their imagination to link the present fault with the last service call and to assume that one is the cause of the other. Unfortunately, not all cases are as clear cut or as easy to prove as the one I have just described.

While on the subject of public relations, here is another story which involved personalities as well as technicalities. Fortunately, it wasn't quite the serious situation portrayed in the previous story.

Most servicemen, I suppose, have encountered the job which has seriously embarrassed them and, to use an old phrase, "endangered a beautiful friendship."

In fact, this did involve a rather attractive member of the fair sex, a family acquaintance, who rang to inquire



"You may have some trouble locating the difficulty. I know I sure did!"

(P. F. Reporter)

whether I could attend to a fault in the household radio. I couldn't, as it happened, because I was in the very act of packing for a few days' holiday, beginning on the following morning. However, thinking little of it, I suggested that she ring a serviceman acquaintance who lived not far from her address.

There the matter was forgotten until

a few weeks later, when I received a phone call beginning "You know that set..."

It seemed that the friend had been duly rung, had made whatever repair was necessary at the time, since "...It has never gone properly. It whistles and squeals...no, not all the time...but often."

Would I please pick it up sometime and fix it? She had not the slightest intention of giving it back to "that chap you recommended!"

Well, I picked the set up, as requested, with the intention of running it in the shop to give any intermittent troubles time to show up. In fact, nothing very definite did show. The octal valve socket pins seemed a bit sloppy and were tightened; a slightly noisy 6K8 was replaced but it just played and played and played!

Hopefully, I took it back, only to learn, later, that it was still as bad as ever. That just about put me in the same boat as my confrere.

Again I picked the set up and again I let it run and run in the shop until one morning, on switching on, it failed to produce the anticipated sound. Turning up the volume control, and tuning, produced a series of heterodynes; the set was

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as unstable as a 5-valve mantel set could be.

Peering in the back of the cabinet, I tapped valves, pushed them harder into their sockets, earthed shields and so on, but without result. It kept right on oscillating and producing microphonic noises when tapped anywhere at all.

Unfortunately, by the time I had removed the chassis from the cabinet and propped it up where I could get at the underside, everything was back to normal. All I could hope was that it would recur spontaneously or, if not, yield to the old tap-and-probe technique.

But the trouble didn't recur spontaneously within the time that my patience held, so I resorted to tap-and-probe.

Fortunately a round of tapping produced a noisy, microphonic condition but so sensitive that it responded to tapping almost anywhere. But a patient series of lighter and still lighter taps with the end of a pencil revealed the fact that it involved two pieces of shielded braid, which crossed one another at right angles just near the volume control.

But why? The two pieces of braid, although not soldered where they touched, were each solidly earthed. I could see the earth points!

But wait. One piece was earthed to a lug, which provided a return for a variety of other components around the IF stage. It was joined to nothing else. What if it wasn't a good earth?

A slight push told the rest of the story. It wasn't a good earth. The lug was slightly loose beneath the nut which was supposed to lock it against the chassis. Presumably, this fact, together with a layer of paint and/or resin which had run down from the soldered joint, had produced the intermittent condition.

With a sigh of relief, I tightened the nut, soldered the two pieces of braid together and then ran a length of tinned copper to the nearest adjacent earth point.

When will people wake up to the fact that a solitary lug, bolted against a metal chassis, isn't a safe earth? If it can't be a soldered joint, then at least, all such lugs should be joined together with a run of tinned copper, to guard against any one of them behaving as this one did.

Incidentally, the lady and I are still friends!

SMOKING CRYSTAL

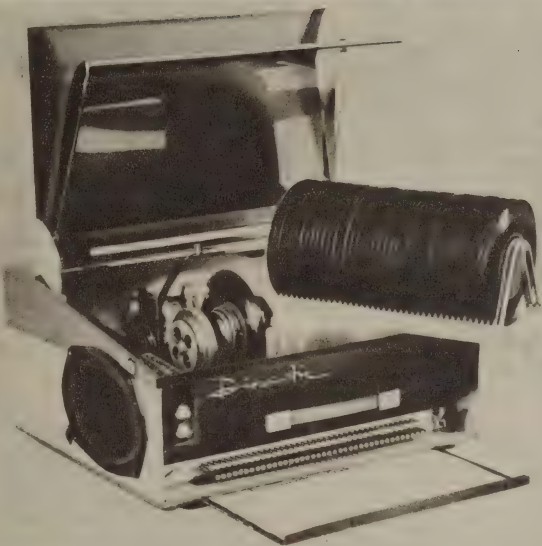
And to finish off, here is an interesting letter from a reader, Mr P. H. R., of Lower Hutt, New Zealand. After saying some nice things about the Serviceman stories, he goes on to describe a record player with a most unusual symptom. He suggests other readers might find it interesting. Here is the story.

"A record player was brought in for servicing with the rather nondescript symptom—'It doesn't go.' It was one of the more common types which uses a solid state power supply and a single triode/pentode valve (ECL82/6BM8) as both preamp and amplifier.

"It seemed a simple enough job and the player was plugged into the mains and the volume control turned full on in case the fault could be a weak cartridge or something similar.

"Imagine the surprise when, as the valves warmed up, the cartridge began to emit smoke. 'Nonsense,' you will say, 'Who ever heard of a piezo crystal car-

A NEW WORRY FOR SERVICEMEN?



A new record changer called the DISCOMATIC was unveiled recently which may well make it possible for every home to have its own "juke" box. Developed in Switzerland by Engineer Jean Foufounis, President of Gerinvex, S.A., the Discomatic excited the attention of the U.S. phonograph industry when it was demonstrated in New York. The Discomatic record changer makes it possible to load 40 seven-inch records into a portable rack, press up to 80 buttons for the selection desired, and sit back and relax while listening to from four to eight hours of uninterrupted music.

The secret is an ingenious record handling mechanism, precision-made, that is operated entirely by one small electric motor which runs at a constant speed all the time the machine is on. This mechanised, as opposed to electrical system activates the record selector controls, record pick-up and return, and supplies the power for spinning the records at either 33 1/3 or 45 r.p.m. The pick-up is coupled to a transistor amplifier and speaker, encased in a smartly designed case, and covered by a plexiglass dome that fits over the entire system for protection and carrying security.

The Discomatic has been available for some months in Europe and is now on the U.S. market. The inventor, Mr Foufounis, designed the record changer for seven-inch records only, because of his belief in the need for a "freedom of choice" in recorded music.

ridge smoking?" But be assured it really did smoke.

"After switching off in a hurry, a quick check with a meter solved the mystery. The culprit was a short between plate and grid in the triode section. The fact that the volume control was full on only helped accelerate the damage.

"A new valve and a new cartridge to replace the rather 'cooked' one soon put the player back into order.

"But it never pays to think you've seen everything."

Well, thanks Mr P.H.R. for an interesting and amusing little story. I agree that there are probably few servicemen who have experienced anything quite like it.

However, I feel that there is one minor point which should be clarified. Which of the two plates, pentode or triode, was involved in the short to the triode grid? Mr P.H.R.'s letter suggests

that it was the triode, and this would be a natural assumption on the basis of probability.

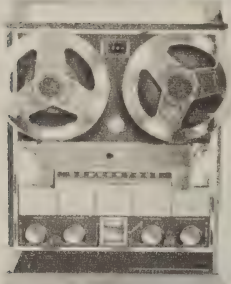
On the other hand, a rough sketch which accompanied the letter suggests it was the pentode plate, and further consideration tends to support this idea. The main reason is that the triode plate circuit would consist of a fairly high value resistor, typically 100K or 220K which would severely limit the current flow possible from this source. In view of the violent reaction within the cartridge, it seems unlikely that such a high resistance source could be responsible.

But the pentode plate could deliver quite a wallop, and seems a much more likely culprit. True, a short between the triode grid and pentode plate is less likely, but it is not impossible if a scrap of conducting material was floating around inside the envelope.

Which only makes the whole story more remarkable.

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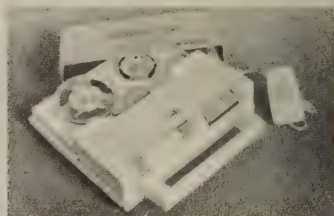
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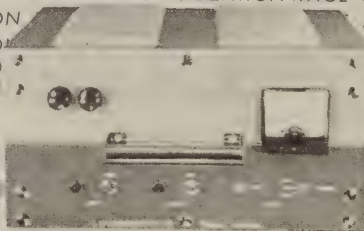
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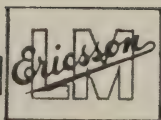


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A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

POWER SUPPLY FOR EXPERIMENTERS

From Mr B. Currie, c/- B.S.L., Carrum Downs, Victoria, comes the following article describing a variable power supply. The supply is intended for experimental use and will deliver up to 80mA at a voltage variable between about 30 and 250V. It uses easily obtainable components, many of which may be in the traditional "junk-box." Mr Currie writes:

THIS article describes a fully variable power supply for powering experimental projects, etc. It uses an ordinary full-wave valve rectifier and filter system, which is followed by a power triode valve (an 809 transmitting type, available from disposals) in series with the HT line.

"The bias on this valve can be varied, by means of the potentiometer connected between its plate and earth. The potentiometer acts as an output voltage control, since it varies the conductance of the valve and thereby the voltage drop across it. The action of the control is quite linear as the valve is virtually connected as a cathode follower. The output voltage can be reduced to about 30 volts for no output current.

"I had considered using some source of negative voltage at the 'earthy' end of the voltage control to reduce the minimum voltage to zero, but decided that this was not worth the trouble. For the applications envisaged for the supply such low voltages would rarely be required.

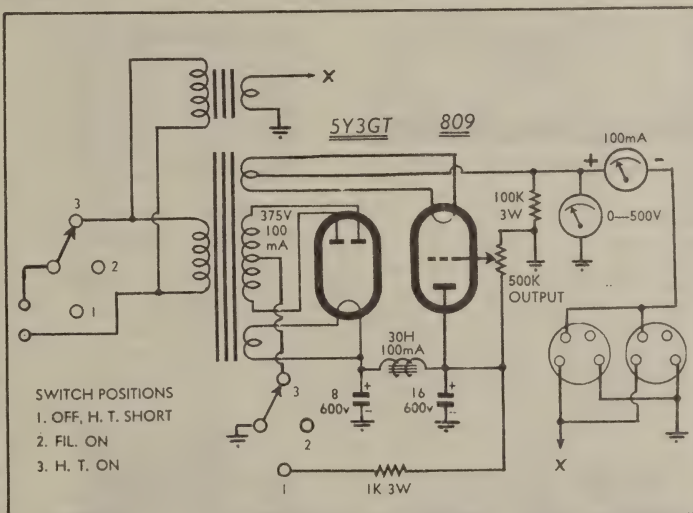
"The 2-pole 3-position switch allows the HT to be switched off while leaving the valve filaments still running. Thus minor adjustments can be performed without having to wait for the filaments to warm up each time the supply is turned on.

"HT output is taken from a centre tap on the 809 filament winding. A 100K 3W resistor was fitted from 809 cathode to earth to avoid contact potential from the 809 giving a voltage reading in the 'Fil. on' position of the switch. The switching was arranged to short the HT through a 1K 3W resistor in the 'off' position.

"Since both valves are directly heated, warm-up time is only a few seconds.

"The 0-500V output voltage meter used in the prototype supply was actually made up from a 500uA meter in series with a 1M multiplier resistor which was selected for close tolerance. However it would be in order to use any pre-calibrated voltmeter available, or any meter up to say 5mA together with a suitable multiplier.

"It should be noted that the design



is quite flexible; almost any transformer, rectifier, filter, power valve and metering circuit could be used, provided current and voltage ratings for the various components are not exceeded.

"In the original, the output was taken by means of a four-pin plug with a length of domestic three-core cable to the unit being powered. However, terminals could be used instead, and in that case

it would not be necessary to ground one side of the filament supply as was done in the original.

"A separate heater transformer was used in the original supply, as the 809 filament used the heater winding on the main transformer. However, if a transformer having an additional 6.3V winding and sufficient power rating is available, it could of course be used."

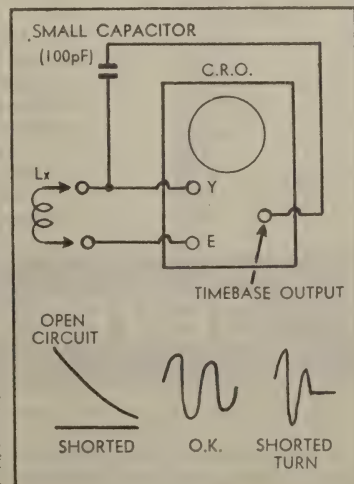
TESTING INDUCTORS FOR SHORTED TURNS

From Mr H. A. van Bilsen, of 109 Hume Street, Goulburn, N.S.W. comes the following information concerning a simple way of testing inductors using an oscilloscope. While the idea is not new, it may not be known to many readers who possess such an instrument.

BASICALLY the idea is to connect the inductor to the vertical or "Y" input terminals of the oscilloscope and set it ringing by feeding it with pulses derived from the oscilloscope timebase. If the oscillations are observed to die away only slowly, the inductor has no shorted turns, while rapid decay shows that shorted turns are present.

No oscillations at all indicate either a complete short, which gives a horizontal line or an open circuit, in which case the trace is simply that of the decaying timebase pulse.

The pulse fed to the inductor is derived from the "timebase out" terminal of the oscilloscope via a small capacitor.



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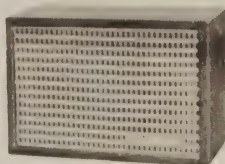
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£22/16/3. 12-1P 12 volt negative to earth £30/1/6.



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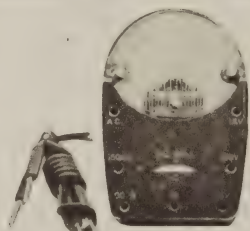
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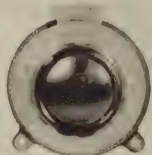
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BABY TESTER

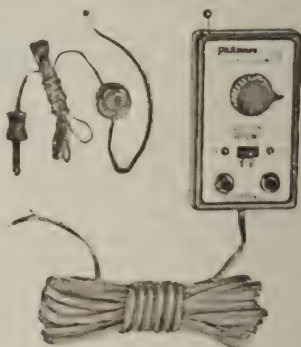
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What are

DRY REED SWITCHES?

One of the most intriguing pieces of electronic hardware to appear on the market in recent years is the dry reed switch or relay insert. Originally designed for telephone exchange switching, it has quickly established itself as an extremely useful device in a wide range of industrial electronic applications.

INTEREST in the magnetic reed switch was first aroused by the telephone industry's constant search for an inexpensive, reliable crosspoint for telephone switching networks. However, it was soon apparent that it had a much wider field of application and is now finding acceptance in the engineering world on a very wide scale.

Electrically, the dry reed relay offers nothing new; it is simply a pair of contacts which can be opened or closed in response to a magnetic field and, in this respect, would appear to be little different from the conventional mechanical relay which has been standard since the early days of telegraphy.

Mechanically, however, it has many unique features.

One of the most attractive is its complete simplicity. Two slender cantilevers of magnetically soft material are fused into the ends of a glass tube. The extreme ends of the reeds align and overlap, separated by an airgap of about .01in. When the assembly is placed in a magnetic field, the ferromagnetic reeds become part of the magnetic circuit and the overlapping ends of the reeds assume opposite polarities. If there is sufficient flux, the stiffness of the reeds is overcome and they flex and touch. The reed tips are plated with precious metal contact material and a switch action is obtained.

The sizes of the units vary, but one of the larger ones has a glass tube diameter of .217in and a length of 2in. Overall length, including leads, is 2.75in. By comparison, one of the smaller units is only .15in diameter, .8in long (glass) and 1.45in overall.

To minimise the adverse effects of arcing, due to oxidation, the tube is either evacuated or filled with an inert gas. The choice between these two, and the type of gas if one is used, depends on the intended application, particularly where extreme conditions are envisaged.

The result is a sensitive, magnetically operable pair of contacts, which are completely sealed against contamination; the oxygen of the atmosphere, dust, magnetic particles, industrial fumes, salt atmosphere, etc. The magnetic field to operate them may be provided by either an electromagnet (a coil wound around the glass tube) or a permanent magnet brought into close proximity.

When correctly used, the reed switch has a very long life. The actual life is primarily dependent on the load to be carried and interrupted. As load currents are increased, the reeds are subject to the erosion of materials experienced with conventional contacts. This causes loose particles of material to build up in the air-gap until a complete bridge is formed.

Variations in the characteristics of the reeds become apparent before com-

plete bridging occurs. The narrowing air gap decreases the reluctance of the magnetic circuit, tending to bring the operate and release levels closer together and the contact resistance becomes unstable.

The frequency of operation also has a bearing on the life of the switch, since it has rather poor thermal conducting ability. Some switches contain several atmospheres of hydrogen to improve heat dissipation.

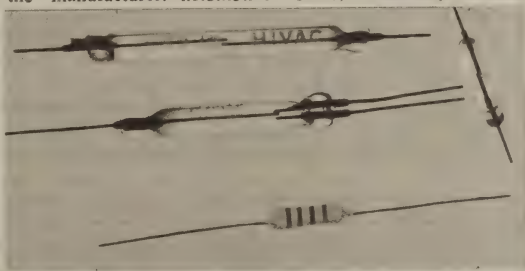
Typical life expectancy is of the order of 10^6 (100,000,000) operations when the current is limited to the "Long Life Rating" issued by the manufacturer.

This would range from 100mA for the smaller sizes to 250mA for the larger ones. However, the larger ones can be operated at up to 1 amp with some reduction in life expectancy which, however, would be perfectly acceptable in many applications.

On the other hand, the dry reed switch is finding particular application in circuits where currents and voltages are very low; too low to break down non-conducting films which may exist on normal relay contacts. The gold-plated reed switch is the most practicable answer to this problem. Gold-plated contacts, sealed against the ingress of moisture, oxygen and other film-producing agents, enable completely reliable switching to be achieved over a life of several hundred million operations.

The contact rating of reed switches is limited to some extent by the low contact pressures available compared with conventional switches. Reed spacing, the type of gas and the gas pressure determine the maximum voltage, which is usually of the order of 250 volts. The maximum load rating is normally about 15 watts. Higher ratings are achieved in some cases by using special contact materials and by increasing the air gap.

Another feature of reed switches is their high switching speeds. Closure times of less than 0.5 milliseconds are possible, with 2 milliseconds typical. Release times are normally from 0.5 milliseconds to 2 milliseconds. Closure times can be decreased by increasing the magnetomotive force; however, contact



	XS2		XS6
Contact Ratings (Recommended Maximums)	1 amp.		
Contact Ratings for Long Life	250 mA		100 mA
Contact Plating	Gold Rich		Diffused Gold
Overall Length	2.75 ins.		1.45 ins.
Glass Length (Maximum)	2.0 ins.		0.8 ins.
Diameter (Maximum)	0.217 ins.		0.15 ins.
Just Operate Ampere Turns	XS2/1 60-75 XS2/2 75-90	XS2/3 90-105 XS2/4 105-120	20-50
Release Ampere Turns	XS2/1 30-55 XS2/2 35-60	XS2/3 40-65 XS2/4 45-70	5-20
Breakdown Voltage	>750 V to 1 KV (according to type)		>300 V D.C.
Operate Time	<2 milli secs.		<1 milli sec.
Contact Resistance incl. Lead Resistance	<50 milli ohms.		<200 milli ohms.
Insulation Resistance	>5 x 10 ¹¹ ohms.		>10 ¹⁰ ohms.
Resonant Frequency	900 c/s.		>2.5 Kc/s.
Test Coil	10,000 Turns of 43 SWG enamelled copper wire wound on a former of 1 1/2" length and 1/4" diameter		P.O. Resistor spool No. 12 with 5,000 turns of 42 SWG. Enamelled copper wire

A group of typical dry reed switches (top) and (above) portion of a data sheet describing two of them. An XS2 is at the top of the picture and an XS6 at the right. A changeover type is in the centre with a half-watt resistor below it. All are shown approximately natural size.

ELECTRO-MAGNETIC MICROPHONE

Specification:

Impedance at 1000 CPS

—2000 and 150 ohms

Sensitivity at 1000 CPS

—46 db above 1 microvolt across a 300 ohm load per dyne per square centimeter free field pressure at the transmitter.

Equalised Response

—Within 3 db from 200-4000 c/s.
Response rises at 7 db per octave

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—Recoil. 1 pair. 1 shielded.
—Leaf type, make.

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bounce is proportional to the actuating force up to the level at which the reeds saturate. The operating ampere-turns figures recommended in manufacturers' data sheets are usually a compromise between speed of operation and bounce duration. The bounce time is normally included when stating the operate time.

The sensitivity of reed switches is built in during manufacture. Operate levels are dependent upon reed overlap and air-gap, while release levels are determined by the stiffness of the reeds. Typical operate levels are 70 to 100 ampere-turns and release levels 30 to 60 ampere-turns.

The basic reed configuration forms a normally open switch (A). A normally closed contact (B) can be produced by including a bias magnet in the magnetic circuit. Change-over contacts (C) are achieved by the addition of a second reed switch and magnetic or mechanical biasing.

Alternatively, there is now available a changeover type reed assembly (illustrated). This has two short contacts at one end and a long contact at the other. The long contact is mechanically biased against one of the short contacts, moving to the other contact under the influence of a magnetic field.

Another attractive feature of reed switches is relatively low cost. Types such as the XS2, even when bought in small quantities, cost about 10/ on the Australian market, which is a very reasonable figure for a component with such unique properties. Naturally, distribution costs are less for larger quantities.

The reed switch is finding a variety of applications in many industries. The basic reeds are suitable for almost every low level switching application and functional combinations of reeds may be used as relays, logic elements, switching networks such as crossbar matrices, selectors and commutators or computing elements such as flip-flops, counters, adders and shift registers.

A number of broad suggestions are illustrated in the accompanying diagrams. Those employing electromagnetic fields are, in general, similar to those already possible with conventional relays, though possibly more satisfactory in regard to cost, size, reliability, etc.

Permanent magnet operation, on the other hand, would seem to offer more scope for completely new applications, or high orders of improvement over conventional methods.

A typical example is its use in place of conventional mechanical door and window contacts in burglar alarm systems. Mechanical contacts have several disadvantages; they are not always as reliable as they need to be, leading to alarm failures or false alarms; they are not easy to conceal, and they are often relatively expensive if a high order of reliability is sought.

The reed switch overcomes all these objections. It is small enough to be housed in a simple recess cut in a door or window frame and becomes virtually invisible when covered with putty and paint. Similarly, a small permanent magnet may be mounted in the door or window in such a position as to close the reed contacts when the door or window is closed. The system has near perfect reliability, is virtually invisible, and is relatively inexpensive.

A completely different application is found in the medical sphere. People with certain heart defects can be given a much longer expectation of life by means of an implanted pacemaker; a simple

electronic pulse generator which delivers regular stimuli to the heart muscles.

However, such a pacemaker, once implanted, cannot be turned off or its speed altered without recourse to surgery, and there are times when both of these requirements may need to be met.

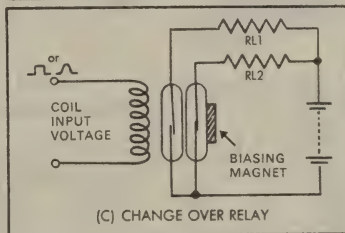
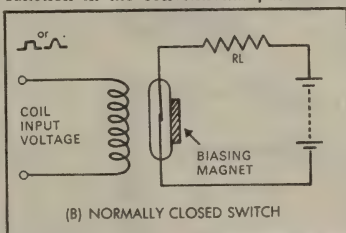
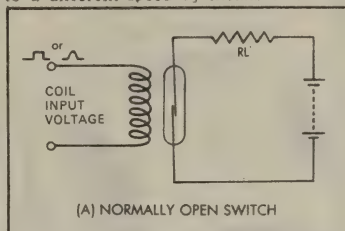
In some cases, for example, natural heart stimulation may recur spontaneously and, if it does, there is a risk that it may conflict with the pacemaker pulses in a manner which leads to ventricular fibrillation, a condition which is invariably fatal if not treated immediately—usually involving surgery. If the pacemaker can be turned off when natural rhythm recurs, this can be avoided.

Again, it is often necessary to change the speed of the pacemaker, particularly during the post-operative period after implanting.

Until the advent of the reed switch there was no way of performing either function in the conventional pacemaker.

In 1964, J. Weinman, of the Rogoff Laboratory for Medical Electronics, Jerusalem, described the use of a reed switch in an implanted pacemaker, actuated by a permanent magnet outside the patient's body, to switch the pacemaker on or off as required.

At the present time, an Australian manufacturer is marketing a highly successful pacemaker which may, according to the type, be switched off or switched to a different speed by means of an ex-



These diagrams show typical applications for the reed switch when actuated by an electromagnet. Many variations of these basic ideas are possible, including multiple reeds in a single winding and multiple windings for one or more reeds.

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7 $\frac{1}{2}$, 3 $\frac{3}{4}$ ips

SPEED ACCURACY:
 $\pm 0.3\%$ from nominal

WOW AND FLUTTER:
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FREQUENCY RESPONSE:
40-18000 cps at 7 $\frac{1}{2}$ ips
 ± 2 dB — 3dB
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 ± 2 dB — 3dB

INPUTS PER CHANNEL:
1. Microphone 3mV at 0.5 Mohm, Max 600 mV
2. Radio 50mV at 1 Mohm, Max 10V
3. Aux. 3-50mV at 47 kohm

LINE VOLTAGES:
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Approx. 45 lbs.

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The capstan is driven by a hysteresis-synchronous type motor with pole-switching to provide the two speeds. Spool sizes from three inches to 10 $\frac{1}{2}$ inches can be used and an end-of-tape cut-off is incorporated. It will rewind 2,400 feet of tape in less than 80 seconds.



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ternal magnet and an internal reed switch.

Yet another use is by model railway enthusiasts, to detect the movement of a train into or out of a section. The reed switch is buried in the track and a suitable magnet suspended beneath a unit of rolling-stock. As the train passes over it, the reed switch closes momentarily and may be used to pull in a locking relay which indicates that the section of the track is now occupied.

These are but a few typical applications, in quite different fields, which give some indication of the versatility of these units. The possibilities are almost unlimited and any electronics engineer faced with an industrial control problem might well stop and consider whether the reed switch may solve it.

MAGNETS

Quite simple permanent magnets will operate the reeds in most applications. What are known as "stick-cast" magnets (they are cast in "sticks" which are subsequently broken up into individual magnets) and which are commonly used for magnetic door catches and similar functions are quite suitable for many jobs. A typical unit, measuring $\frac{1}{2}$ in x $\frac{3}{8}$ in x $\frac{7}{32}$ in, and capable of lifting a 7oz steel block, will pull in a typical large reed switch at $\frac{3}{8}$ in and release it at $\frac{5}{8}$ in.

Reverting to electromagnetic applications, a lot of interest centres on the power or ampere-turns needed to operate various types and combinations of reeds, and the coil designs necessary to achieve this.

Combinations of reeds, within a single coil, are used to simulate the conventional multi-contact relay. By using both single-contact and changeover types, quite a wide range of functions can be provided, with the added advantage that the individual can make up any combination to suit his requirements.

At the same time, it should be emphasised that the dry reed relay is not an automatic replacement for the conventional relay. While it will do a better job and provides greater design flexibility in many applications, there are still a great number of jobs best performed by the conventional relay. This applies particularly where large numbers of contacts are required on a single relay and/or heavy currents are involved.

Australian manufacturers are currently producing a range of reed relay bobbins and coils which are suitable for most of the reed switches currently available. The bobbins are designed to cater for a variety of component mounting techniques, including printed circuit, metal chassis and post-office 2,000-type mounting practice.

Reed switch data sheets normally specify either the power, in milliwatts, or the ampere-turns necessary to close the contacts. Most coil design is based on ampere turns data. Data sheets normally specify the "Just Operate Ampere-Turns" and most coil design includes a safety factor (say 1.5) to ensure positive operation.

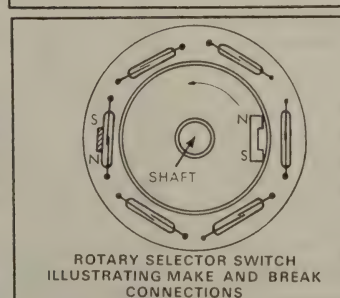
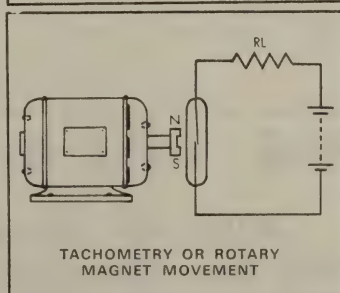
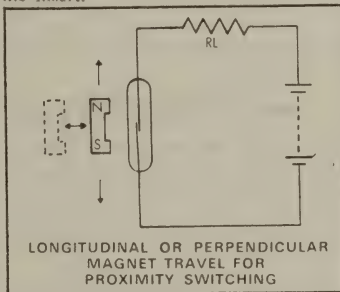
The following information is presented for the use of engineers or experimenters who wish to design their own coils for operating dry reed inserts. Simple coils suitable for operating one or two inserts are discussed, but the design principles may be extended to more complex coil assemblies. For ex-

ample, two coils wound on a common bobbin may be designed to produce a latching relay, an AND gate, or an OR gate.

The operate parameters given in dry reed insert data sheets are based on the use of the insert in a standard test coil. The length of the test coil is approximately the same as the glass length of the insert. Shorter coils can increase the efficiency of the relay by reducing the number of ampere turns required to operate the insert, but the relative positions of the coil and insert become more critical as the coil length is reduced and a small displacement of the insert can have a large effect on the operate sensitivity of the relay. The operate and release times of the relay are largely dependent upon the coil characteristics, coils with higher Q giving faster operation.

For normal use, it is recommended that the coil length be similar to that of the test coil for the appropriate type of insert. This will enable the operate parameters given in the data sheet to be used without modification.

In order to achieve fast operate time without excessive contact bounce, single insert coils should be designed to operate at 1.5 times the operate ampere turns of the insert, and two insert coils at 1.75 times the operate ampere turns of the insert.



Typical applications using permanent magnets to actuate the reeds. Many variations on this theme are also possible.

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Full technical information & illustrations on request.

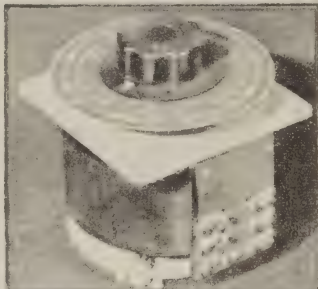
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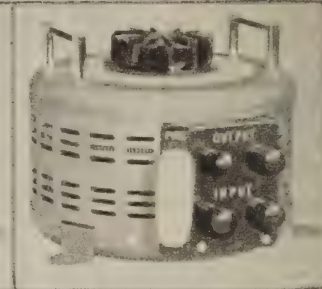
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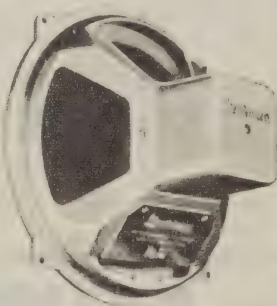


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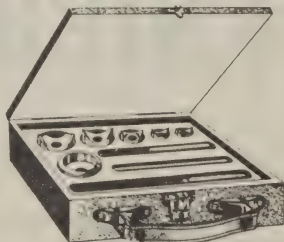
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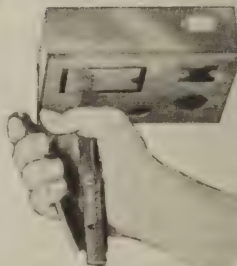
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The basic expressions necessary for the calculation of one and two insert coils are given below:

(a) Physical Characteristics.

Depth of winding, $B = \frac{N}{na}$ in.

Length of average turn (single insert coil), $P = \pi(d + B)$ in.

Length of average turn (two insert coil), $P = \pi(d + B) + 2s$ in.

Total length of wire, $L = \frac{PN}{36}$ yd.

Overall winding dia., $D = d + 2B$ in.

(b) Electrical Characteristics.

Resistance of winding, $R = \frac{Lr}{10^3}$ ohms.

Current through coil, $I = \frac{X}{N}$ amps.

Coil supply voltage, $V = IR$ volts.

N = Total number of turns.

n = Number of turns per square inch for a given gauge of wire.

a = Length of winding.

d = External diameter of central core.

r = Resistance of wire per 1000yd.

X = Design ampere turns.

The following examples illustrate methods of coil design:

(1) Information known:

Design ampere turns (= 1.5 times operate ampere turns of insert).

Coil current.

Bobbin dimensions.

Information required:

Wire gauge.

Coil supply voltage.

Method:

We have, $B = \frac{N}{na}$

and $N = \frac{X}{I}$

hence $n = \frac{X}{IBa}$

Choose the gauge of wire having the number of turns per inch nearest above the value calculated.

Find the actual depth of the winding.

$B' = \frac{N}{na}$ and calculate the coil supply voltage required from,

$V = IR$

$= I \cdot \frac{Lr}{10^3}$

$= I \cdot \frac{PNr}{36 \times 10^3}$

$V = \frac{I \pi (d + B') Nr}{36 \times 10^3}$

(2) Information known:

Design ampere turns (= 1.5 times operate ampere turns of insert).

Gauge of wire to be used.

Number of turns.

Length of bobbin.

External diameter of central core of bobbin.

Information required:

Overall diameter of winding.

Coil current.

Coil supply voltage.

Method:

We have, $B = \frac{N}{na}$

and $D = d + 2B$

hence $D = d + \frac{2N}{na}$

Coil current,

$I = \frac{X}{N}$

Coil supply voltage from example (1),

$V = \frac{I \pi (d + B) Nr}{36 \times 10^3}$

(3) Information known:

Design ampere turns (= 1.5 times operates ampere turns of insert).

Bobbin dimensions.

Information required:

Wire gauge.

Coil current.

Coil supply voltage.

Number of turns.



Typical coil bobbins for use with reeds. In the top row are four, two and one reed bobbins for the larger (XS2) type reeds. At lower right are one and two reed bobbins for the smaller (XS6) type. At lower left is a four reed bobbin with a 10000 ohm winding. Bobbin dimensions quoted in the formulas are given on page 61.

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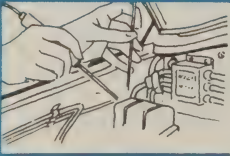
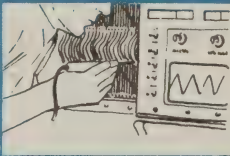
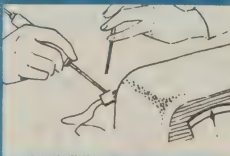
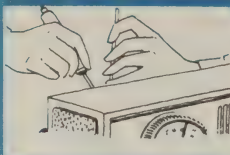
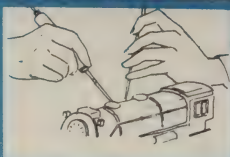
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Method:

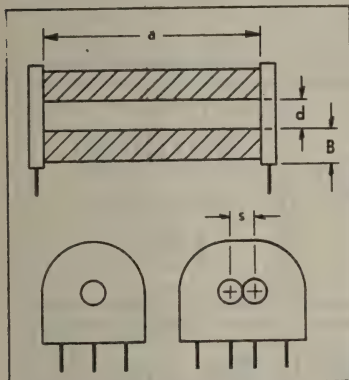
Since it is possible to use a number of different combinations of turns and wire gauge to obtain the same operating conditions, it is necessary to stipulate either the wire gauge or the number of turns before the other coil parameters can be calculated.

If the number of turns are specified, the problem becomes similar to example (1).

If the wire gauge is specified, the number of turns is calculated from $N = \frac{B}{B_{na}}$.

This figure can be rounded off to a convenient value below that calculated and the other coil parameters are obtained as in example (1).

N.B.: the values calculated from the equations given above are theoretical, and may differ slightly in practice due to



The essential dimensions of a bobbin as required for the formulas on the previous page.

the variation in coil winding efficiency, etc.

We wish to acknowledge the very valuable assistance, technical data and diagrams, given us by the following firms:

Ducon Condensers Pty. Ltd., P.O. Box 2, Villawood, N.S.W. Australian agents for "Hivac" Dry Reed Relay Inserts.

Telephones and Electrical Industries Pty. Ltd., Faraday Park, Meadowbank, N.S.W., manufacturers of reed relay bobbins and coils.

Rola Company (Aust.) Pty. Ltd., Prince's Highway, Noble Park, Victoria, and 167-187 Kent Street, Sydney, N.S.W., manufacturers of a wide range of industrial magnets.

OTHER ARTICLES

(1) Wagner, H. N., Measurement Techniques for Characterising Sealed Reed Contact Performance. IEEE Transactions on Component Parts, December 1964, pp 8-12.

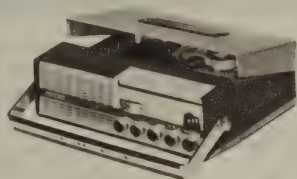
(2) Hovgaard, O. M., and W. J. Fontana, A Versatile Miniature Switching Capsule, Proc. Electronic Components Conf., 1959, pp 32-37.

(3) Weinman, J., The Incorporation of a Magnetic Switch into an Implanted Pacemaker. Journal Thoracic and Cardiovascular Surgery, October, 1964, pp 690-692.

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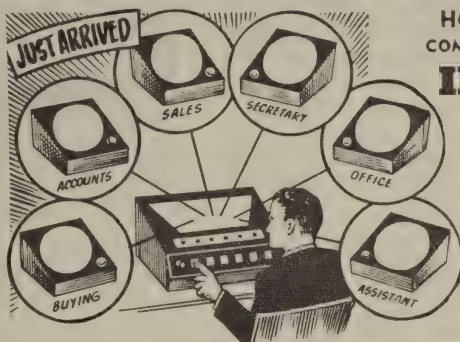
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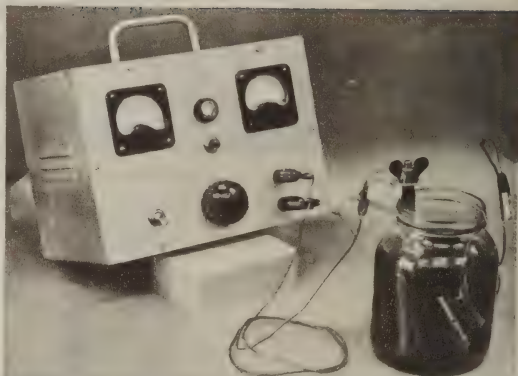
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PLATING at home...

Every so often we are asked for information about home electroplating — what sort of anode to use, the composition of the electrolyte, the current density, and so on. This article is intended as a guide to the home plater, and gives the essential information concerning copper, nickel, gold, silver and rhodium plating. It also describes electrolytic cleaning and aluminium anodising.



HOME plating normally does not require expensive or highly elaborate equipment. One can plate small objects such as keys, cutlery, small radio components and jewellery using nothing more than a pint or two of electrolyte in a glass jar, a piece of metal for an anode, some copper wire and a 3V cycle battery. With the addition of a thermometer and using a variable voltage supply to replace the battery it is possible to carry out many of the operations performed in a commercial plating shop.

The photograph shows one variable supply which may be used for plating, the "Transistor Regulated Power Supply" of April 1962. However if this supply is used it would be wise to fit it with a series resistor to protect it against accidental shorting of the output. A 3.5 ohm resistor would be suitable in most cases.

A number of small imported variable supplies are currently available which would also be suitable. These are usually capable of delivering 200 milliamps or so, and would be quite suitable for plating small objects and jewellery.

It is an advantage to have an ammeter to monitor the plating current, although such a meter is by no means essential; similarly a voltmeter is a worthwhile but not essential addition.

Most home plating can be done with no more than a quart of electrolyte in a glass or plastic container, together with a similar container for the cleaning bath. Gold, silver and rhodium plating solutions should be used in glass jars, so that they can be fitted with airtight screw caps when not being used. This is desirable to prevent decomposition of the cyanide-based electrolytes, and also to prevent contamination with dust, etc.

In the case of gold and rhodium plating solutions, the use of a glass jar also allows the plating bath to be safely heated to the correct working temperature. This is done by placing the jar in a dish or tin of hot water—not by directly heating the jar.

With the exception of rhodium plating, the financial outlay will usually be quite modest. Chemicals for making up a gallon or so of copper or nickel plating electrolyte will typically cost about 10/,

...what you need to know

while a piece of copper or nickel for the anode will be 5/ at most.

Commercial salts to make a quart of silver or gold plating electrolyte typically cost 20/ and 26/ plus tax, respectively, and, if stainless steel is used for the

ordered through the local pharmacy. Nickel foil for an anode may be obtained from the same suppliers.

Gold, silver and rhodium plating salts, electrolytic cleaning salts and precious metal anode material may be obtained from precious metal refiners. One such firm, Matthey Garrett Pty. Ltd., has offices in Sydney, Brisbane and Richmond, Victoria, and will supply materials by mail if payment is made in advance. The Sydney address is 824 George Street.

The first requirement in plating is that the work must be thoroughly clean—and if a polished finish is required, the work must be polished before plating. Plating will not cover up a rough surface, nor will it adhere to a dirty surface.

The amount and type of cleaning re-

by Jamieson Rowe

anode, this will cost only a few shillings. Fine silver or gold anodes, if used, will be more expensive—about 25/ for a typical silver anode for jewellery work, and about 70/-90/ for a fine gold anode of similar size (both plus tax).

Rhodium plating is somewhat more expensive, with a bottle of salts to make up one litre of electrolyte typically costing 108/ plus tax. For serious plating in

WARNING!

PLATING and electrolytic cleaning solutions are highly dangerous. Most are extremely corrosive, containing either acid or strong alkali. Gold and silver plating electrolytes and electrolytic cleaning compounds contain deadly cyanide compounds.

Parents are therefore strongly warned against allowing children to experiment with electroplating. This article is not presented for the youthful experimenter, but for the responsible hobbyist and amateur jeweller.

Those who engage in plating are warned that they should employ all possible care. After plating, wash the equipment, the plated work and **YOUR HANDS** very thoroughly to make sure that no trace of plating solution remains.

Be particularly careful not to allow salts containing cyanide compounds to come into contact with acid solutions, as highly poisonous gas would be generated.

rhodium a platinum anode is required, and this will typically cost about £10. However it should perhaps be pointed out that the platinum anode is not eaten away!

Where can plating supplies be obtained? Chemicals to make up copper and nickel plating electrolytes can be obtained from the larger chemical suppliers, although sulphuric acid may have to be

quired will depend upon the work itself. If it is greasy, it must be degreased by bathing in an organic solvent such as petrol or trichlorethylene. If clean but dull and oxidised, is should be pickled in a bath of strong acid—a mixture of concentrated nitric and sulphuric acids is often used, called "bright dip."

Small objects such as jewellery and small radio parts can often be cleaned

sufficiently by boiling them for ten minutes or so in a fairly strong solution of household detergent.

In general, however, it is very desirable to clean the work finally in an electrolytic cleaning bath. Such baths are best made up from commercial salts, which are quite inexpensive—a jar of salts to make up a gallon of solution will typically cost about 3/6d.

Electrolytic cleaning with such salts uses the work as cathode (negative) and

plating of the various metals has been incorporated into a table, to allow easy access. Current density values and times required are only approximate and should be regarded as a guide rather than rigid prescriptions. The following comments may also be found useful.

Before plating, make sure that all trace of the cleaning solutions, polish, etc., is removed from the work. Rinse thoroughly, preferably in distilled water. Before rhodium plating a rinse in distilled

water is virtually essential.

In all plating work the work connects to the **NEGATIVE** terminal of the battery or power supply. Support the work in the plating bath by a hanger of copper wire — clean and untinned, to ensure good contact and prevent bath contamination. Tie the wire to the work loosely, at a place where it will not prevent plating at an important part of the surface.

The current density is simply a mea-

HOME PLATING INFORMATION

PLATING METAL	SUGGESTED ANODE (+)	SUGGESTED ELECTROLYTE	CURRENT DENSITY mA/sq. in.	TEMPERATURE degrees F.	APPROX. TIME	SURFACE METAL OR PRIOR PLATING
COPPER	Copper	2 pints Dist. Water 7oz Copper Sulphate 1oz (16mL) Sul. Acid (ADD ACID TO WATER)	70-250 (1-4V)	Room temp.	1-5min	Nickel plating required before plating copper on iron or steel.
NICKEL	Nickel (foil)	2 pints Dist. Water 4oz Nickel Sulphate ½oz Ammon. Chloride ½oz Boric Acid	70-150 (1-2V)	Room temp.	10-20min.	Direct on brass, copper, steel, iron, etc.
GOLD	High qual. stainless steel.	MAKE UP FROM COMMERCIAL SALTS (see text)	10-20 (approx 3V)	110-140	10-60sec	Initial plating of nickel req. for thin gold plating. Otherwise plate on silver.
SILVER	High qual. stainless steel or Fine Silver	MAKE UP FROM COMMERCIAL SALTS (see text)	20-30 (approx 1V)	Room temp. (60 deg. or higher)	5-40sec	Copper plating req. first over soft solder.
RHODIUM	Platinum, or high-quality stainless	MAKE UP FROM COMMERCIAL SALTS (see text)	50-80	100-110	10-60sec	Plates on silver, gold, platinum, copper, nickel, etc., BUT NOT iron, steel, zinc, lead or aluminium.
ELECTROLYTIC CLEANING		Make up electrolyte from commercial salts. Maintain the bath at 180 degrees F. or maximum allowed by work. Use a nickel anode (+) and approximately 6V for about 10-15 seconds. Rinse the work well before immersing in plating bath, preferably in distilled water.				
ALUMINIUM ANODISING		Use a lead or mild steel cathode (—); work is anode (+). Use 12V or more, for 20-30 minutes. The electrolyte is 4oz (70mL) of Sulphuric Acid in 2 pints water. Use aluminium hangers for work. (ADD ACID TO WATER, slowly.)				

a nickel anode, (positive) with about 6V supplied. The salts contain a caustic alkali, a cyanide compound to dissolve oxides and organic matter and possibly a detergent. The current assists by liberating free alkali and hydrogen bubbles at the work cathode (the hydrogen bubbles help shift remnants of grease, etc). Cleaning time is quite short, typically 10-15 seconds, at 180 degrees F. or at the highest temperature below this which the work will tolerate.

As with precious metal plating solutions, electrolytic cleaning solution should be kept in a jar fitted with a screw cap. This is for safety and also to prevent decomposition of the cyanide compound. The jar may well be used for the cleaning bath, as this will allow safe heating in a water bath.

At this point it should perhaps be mentioned that in checking the temperature of plating and cleaning electrolytes an all-glass or glass-and-stainless steel thermometer should be used. Thermometers with wooden supports, painted scales or base metal supports should not be used as these will cause bath contamination. Make sure that the thermometer is thoroughly washed after being used!

The specific information regarding



For copper and nickel plating the electrolyte is made up from common chemicals including those shown here — copper sulphate, nickel sulphate and sulphuric acid. Commercially prepared plating salts are recommended for precious metal plating, however, as the chemicals required are rather dangerous. The photo on page 64 shows a typical set-up for copper plating.



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Why Directional Microphones?

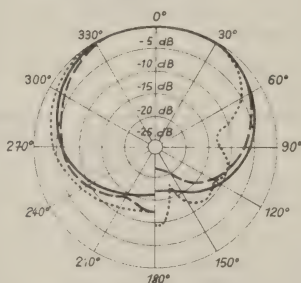
Recordings are often to be made in acoustically unsuitable rooms. The use of non-directional microphones usually produces an unfamiliar reverberant sound with disturbing background noises. This is due to the omni-directional conversion devices being equally sensitive to all directions. Reflected sounds from walls and flat furniture surfaces, and the running sound of the tape recorder will be recorded as well. The human ear is sensitive to direction and it seems therefore only right to use in acoustically unprepared rooms microphones receiving sound from a certain direction with preference, to obtain a natural recording free from reverberation. Thus the desired sound stands out whilst the echoes of the room and background noise are largely suppressed. E.g. the MD 421 with its cardioid directional characteristic is in this way very sensitive at the front whilst it is desirably "dead" towards the sides and above all, at the back. It has the remarkable reduction of response of 16 db at the back*. This value is very favourable for truly natural recordings, as too high a discrimination makes the recording appear "dry." On the other hand, a damping which is too low for unfavourable rooms will result in a reverberant reproduction similar to that of an omni-directional microphone.

Moreover, the discrimination at the back of the MD 421 is to a large extent uniform for all frequencies (see polar diagram). This statement can readily be proved by a listening experiment in which the sound incident comes from various directions. The MD 421 sounds e.g. as natural with sound arriving from the side as with sound originating in front; a clear difference is apparent only in the volume. All these excellent directional properties permit the use of the MD 421 in installations in which loudspeakers are employed in the same hall. It contributes to the elimination of the dreaded acoustic feedback howling.

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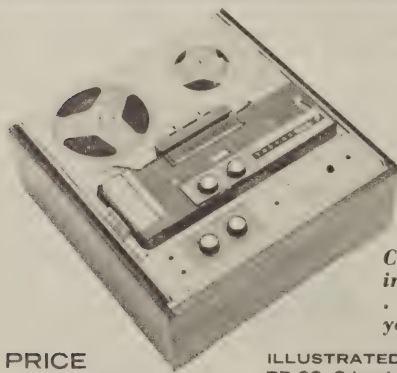
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Polar Diagram

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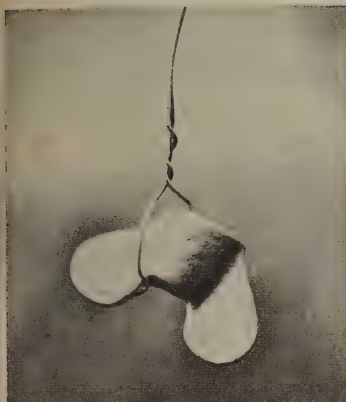
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The photo above shows how a piece of copper wire is used as a hanger to support the work in the plating bath. At right are typical commercial cleaning and plating salts.



sure of the current per unit of total surface area of the work. Estimate the surface area — don't try to measure it exactly, great precision is not required. Multiply the number of square inches of surface area by the current density value shown in the table to find the plating current required.

In general, use the lowest current density which gives a suitable plating thickness in the allowable time. This will give an even, properly adhesive plating. Too great a current density will result in "burning" — a spongy, uneven and poorly adhesive coating.

When plating, it is usually advisable to shake or vibrate the work and hanger during the plating process to ensure that it is not surrounded by exhausted electrolyte. In the case of gold plating, rotation of the work may be necessary to ensure that all surfaces receive an even plate.

The acid copper plating bath recommended will not plate copper over iron or steel. To copper plate these metals it is necessary to first plate them with nickel. Acid pickling may be required before the nickel will adhere reliably to the iron or steel.

When a very thin coating of gold is to be plated, a nickel undercoat is advisable. Otherwise a silver undercoat should be used. With very thin gold coatings silver may tend to diffuse through the gold.

Silver should not be plated over soft

solder. Plate soft soldered articles with copper before silver plating. When rhodium is to be plated on objects made from iron, steel, zinc, aluminium or lead, a copper or nickel undercoat should first be applied.

After all plating, remember to wash the work and other equipment thoroughly — not only in the interests of safety, but because plating solutions are corrosive and will also cause smears and tarnishing of the work. Dry the work with a soft cloth, with hot air or in heated sawdust.

A process allied to but distinct from plating is anodising, which is commonly used to impart an even matte finish to aluminium work. Anodised aluminium can be dyed with organic dyes to produce a most attractive finish, as witnessed by many domestic drinking tumblers and saucepan-lids.

In anodising the surface of the alum-

inium is converted into a thin and even layer of aluminium oxide. This may be produced by immersing the aluminium object in a weak caustic solution (such as sodium or potassium hydroxide), or alternatively by the electrolytic process shown in the table.

In contrast with plating, the work is connected to the positive terminal of the supply and becomes the anode. A lead or mild steel cathode is used, and the electrolyte is dilute sulphuric acid—some 70mL of concentrated acid per quart of water. (Other electrolytes are sometimes used, such as chromic or oxalic acid, but sulphuric acid is usually easiest to obtain.)

Fairly high voltages are employed,

from 12-20V. The current may be quite high, and an accumulator is best used as the supply. The process takes some 20 - 30 minutes. Make sure that only aluminium is in contact with the solution at the positive electrode—use an aluminium strip hanger, or leave part of the job out of the solution.

If an aluminium hanger is used, it should be firmly attached to the job—the anodised aluminium surfaces are very poor conductors.

When anodising is complete, the work should be thoroughly washed. It may be dyed by immersing it in cloth dyes (the colourfast variety is preferable). To make the dyeing fast the work can either be coated with clear lacquer or boiled in water—the latter removes some of the colour, but "fixes" the rest.

And with that necessarily rather brief discussion of anodising we must bring this article to a close. In closing the author would like to gratefully acknowledge the assistance provided by the firm of Matthey Garrett Pty. Ltd., who were most courteous and helpful in providing plating information and details of material availability. Without their assistance the article could hardly have been written.

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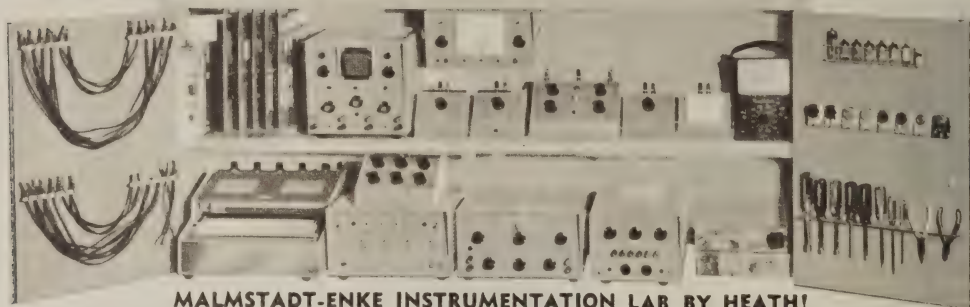


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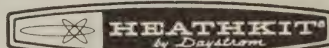
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WARBURTON FRANKI



Forum

As so often happens with these columns, after the tumult and shouting of major arguments have passed, we are left with a collection of "bits and pieces" — observations which came in too late for the mainstream discussion, items that have been passed over, and so on. This is one of those months.

By W. N. Williams

IN the interests of continuity, however, we can begin with the matter of component prices in Australia, which has been the subject of running comment in the past two or three issues.

A point which has been brought to our notice is the relevance to the situation of modern mechanised (or should we say computerised?) methods of accounting and stock control. I don't profess to be an expert in these matters but the broad story, as put to me, is clear enough.

Stock control and accounting has always been a tremendous headache to any manufacturer concerned with large numbers of small, low-cost items, made to a variety of specifications and supplied in a variety of quantities to a variety of purchasers. Resistors, capacitors and other small items common in the electronics industry provide classic examples of such products.

Tight stock control by the old book-and-pencil methods could become costly beyond reason.

"Loose" stock control led to inefficiency through wrong production planning, unwise purchase of raw materials, and such like, with plenty of opportunity for pilfering or other unprofitable "leakage" of stock.

A course which is currently being adopted by industry is to install a computerised accounting system and channel everything through it, so that it becomes a "Big Brother" who hears all, sees all and knows all.

It knows the stock position at any point in time and is fed with all the orders. It issues consignment instructions and invoices, instructs the factory as to what needs to be manufactured, looks after raw material requirements and works out piece-work payments for operators in the factory.

And so on, with variations.

To make all this possible "Big Brother" has to be fed with information in a strictly standardised form and this keeps quite a lot of people busy—so

many, in fact, that the "economies" of computerised operation are currently the subject of much argument in the business world.

But that is another story.

Be that as it may, for big clients and big orders, the system works well and the cost of injecting information to the computer system is small compared with the profits from the transaction.

But here's the rub:

Unless special provisions are made, exactly the same system has to be used and the same process costs are involved for small orders as for large. The system goes through the same motions to handle the sale of 0,000,001 resistor for £000.00.06 as it does for 1,000,000 resistors for £2500.00.00.

What's more, it makes no effort to conceal the average cost of handling each individual transaction. That is one reason why executives, these days, are very conscious of this figure.

In talking to us during the month, one such executive recited something like the foregoing and finished with the refrain . . .

"We've got 'em by the million

But we can't sell you one!"

He then went on to speculate about the possibility of some individual wholesaler acting as a distribution agent for small quantities but ended with the grumble that wholesalers won't think this way and won't spend money individually on reasonable stock.

Which brings us right back to the observations in earlier issues.

What bothers me is why computer systems or other automated stock handling procedures have to be so inflexible.

Surely a manufacturer should be able to set up a small subsidiary stock of his own lines which could be fed in bulk per the computer system but sold in small quantities by the most economical possible means.

Every office has a petty-cash system, which is there to cover small but necessary expenditure on items which are in-

dividually too trivial to warrant separate detailed accounting.

Surely it should be possible for manufacturers to operate this in reverse, to handle sales which are individually unimportant but significant in toto—and significant in more ways than one.

On the subject of kits, G.B. of Townsville, Qld., says that he was interested in acquiring tape equipment along the line of our Playmaster 110. He had thought to build it but found that he could buy it ready assembled for only £6 more than the cost of the kit.

To quote:

"What would be the sense of my fiddling around with a soldering iron, smoking myself silly in the wee sma' hours, only to make a killing of six quid? And that's assuming the whole thing worked when I'd finished!"

He goes on to say that he subscribes to an English journal and indications there are that considerable savings can be effected between buying a kit or buying it ready built. He goes on:

"One of the clues appears to be the sales tax. Here, everything carries a pretty high level of tax whereas, in Britain, the purchase tax varies and, in some cases, does not apply. The situation is such that it is possible to buy, in Britain, the 'works' and 'case' much cheaper than the case with the works already inside."

"Incidentally, one of your advertisers says 'quality assembled test equipment at Kit Price.' Very soon it will be cheaper to buy a completely assembled and tested piece of equipment, simply to tear it apart for the pleasure of building it ourselves!"

A number of readers are obviously intrigued by this latter situation—ready-built kits competitive with kit prices. On the surface it appears plainly ludicrous.

Here again I (or we, the magazine) have no first-hand knowledge of exact costs, because we have no connection with any electronic business house. We originate and publish designs for the benefit of our readers, and it is of no special significance to us whether readers build them up for the pleasure and instruction of so doing or buy them ready made.

However, we do hear comment regarding both activities which tend to explain the situation.

As we have already said, the costs of marketing small quantities of components are very real and multiply as the buyer—

(1) Spreads his purchases over more occasions;

(2) Delays the man behind the counter while he makes up his mind or talks about his problems;

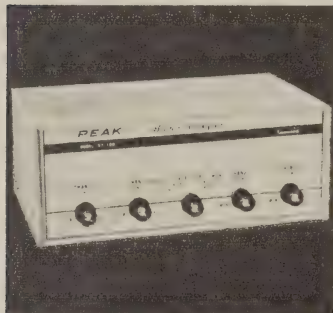
(3) Expects every item to be well packaged and complete with lead connection data.

All these things are very much a feature of over-the-counter selling and

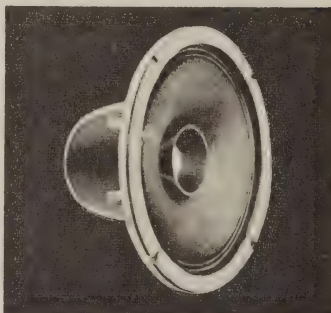
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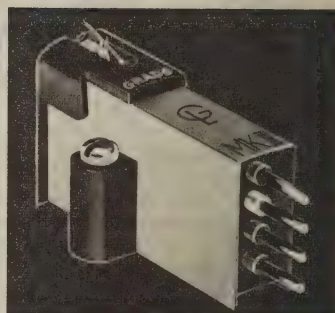
hi-fi equipment



ST-100 stereo amplifier
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6A7 dual cone
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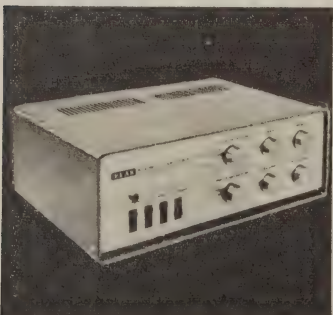
KR 12H 4-speed
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provide the incentive for pre-packaging chain-store presentation, by way of answer.

On the other hand, kits are often assembled by people working privately on a piecework after-hours basis, where the accounting of time may not be so strict. They are supplied with cartons of components bought at good "manufacturers" rates and without packaging frills. They work in their own time, at their own convenience and for an agreed price per finished unit.

Over and above this, there is always the chance of further savings if components can be used which are new and surplus from a manufacturer's stock, but not packaged or salable as a retail item.

As we said in an earlier issue, the situation is as much a comment on the economies of such manufacture as it is on the costs of selling individual components.

I note, by the way, that component costs are the subject of an editorial in a small American publication which reached us recently through the mail. I quote the relevant parts:

"While we all complain about the cost of electronic components, it is interesting to note that the American hobbyist is the envy of his brothers around the world.

"Even our Canadian neighbours (as noted in a recent magazine item) pay much, much more for their supplies.

"In many nations, parts are either completely unobtainable or are priced completely out of the reach of the average worker.

"Even in the more advanced countries, the difference is noticeable. A typical example would be the popular Heathkit VTVM IM-13, which sells here (in the U.S.) for 32.95 dollars. A recent advert in "Teletronics" (Australia) lists the IM-13E (export version differing only in the power transformer and line cord connector) for £30/10/, which translates to 68.32 dollars."

"Couple these prices to a wage scale which is much lower than in the U.S. and, even with their lower food and medical costs, it makes the hobby look much more difficult.

"It is certainly a tribute to the hobbyists that, in Australia the largest electronics magazine has a circulation of 44,000 and, even New Zealand, with a total population under 3 million, supports its own electronics magazine."

Looking back over what has been written, it adds up to a lot more than I had intended to say, but perhaps it's not a bad thing.

If, by ventilating the subject of component costs, some improvement in the situation can be effected, the space and effort will have been well expended.

CORRECT ENGLISH

By way of a change of subject, S.H., of South Melbourne, puts pen to paper in the cause of correct English usage in "Forum" for April last. He precedes his other remarks by the following tale:

"A schoolboy, being asked what 'forum' meant, defined it thus: A place in Rome where the senators used to argue politics and then asked the people to vote; some were for 'em, some were agin 'em; mostly they were for 'em—hence the name!"

Perhaps I should make confession here. Years ago, when these columns were first started, I wanted to use the

... "historic legal precedent"

Dear Sir,

The following matter appears of sufficient interest that you may wish to give it early and appropriate publicity in your journal. It appears that, by a recent decision of the Minister for Customs, Mr Ken Anderson, the traditional high duties imposed on important items of radio equipment imported into Australia from foreign sources may be remitted in certain circumstances.

The Minister was requested to review the following incident: In April, 1965, I sent a 500-cycle bandwidth 455KC mechanical filter to Mr H. N. Bowman, VK5FM, of Bridgewater, S.A., purchased at his request in connection with certain experiments planned between our respective amateur stations in the VHF bands. The filter was estimated for Customs duty at £14/9/, or about 80 per cent of its wholesale price.

Representations were made to the Minister by me and others, indicating the impossibility of procuring such a filter from any Australian manufacturer now or in the immediate future, and its vital importance in a serious research project. It was further emphasised that Australian radio amateurs had traditionally expended much of their limited personal resources to ensure that their equipment was equal to the world's best, exercising great ingenuity in the face of limited availability of appropriate industrial components.

In a letter from the Minister of Customs, dated June 1, 1965, I am advised that it has been decided to admit the filter duty free. I understand that the Minister has expressed to Mr Bowman his appreciation of the "excellent technical description" accompanying the request for removal of duty.

This enlightened and historic legal precedent hopefully opens a new door to the future of the Australian experimenter. As always in such matters, continuance of this attitude by the authorities will depend on respect for the legal intent. It would appear to cover items intended for experimental purposes, and not available from Australian sources. Abuse of this privilege by the irresponsible may well wreck its operation for the many. Let us hope that commonsense will prevail.

As a former Australian now engaged in brain research with many commitments in the area of biomedical engineering, I am ever mindful of the almost incalculable importance of a body of sophisticated technological knowledge in the Australian community. It may well rank with seemingly more specific commitments in the country's development, and particularly in its defence. For this reason, the opportunity to take full advantage of overseas technological developments should be available to the Australian experimenter.

Sincerely yours,

W. ROSS ADEY, M.D.

WB6DEX

(ex-VK5AJ, VK3AJL, G3GPC).

(Professor of Anatomy and Physiology, University of California, Los Angeles. Director, Space Biology Laboratory, Brain Research Institute, University of California, Los Angeles.)

title "Forum—and Aginum," but the late John Moyle, who was then in the Editorial chair, stuck out for "Let's Buy An Argument."

More recently we substituted the word "Forum" as being, perhaps, a little more general in its meaning, but the "aginum" part never got beyond a laugh over morning tea.

Our correspondent goes on:

"In cases where questions are about verifiable facts, the odds are on your staff."

"However, as so often happens with nice, technical distinctions, the definitions revolve more round semantics than facts. Consequently the utmost precision of language is required on both sides.

"It would be pedantic to criticise the use of colloquial or idiomatic expressions in articles which are written in a chatty style. Nevertheless, where concepts are at stake, avoidable errors should be excised."

"Now I must take you up on the use of imply and infer. We should agree that the two meanings are opposite in sense and are not interchangeable. They are precise and, having no suitable substitutes, should not be debased."

"The rule almost obeys Ohm's Law. Implication is a radiation or going out; inference is induction or taking in."

"I, I, they, etc., imply: you infer."

"Terms do not infer. Even had they been human they would still have had to imply, for a second party to make an inference."

"No doubt, you may be able to quote dictionaries which give the words as optional; in good writing, especially of a technical nature, the two thought processes are distinct and opposite. It would be a loss not to have these separate meanings."

The reference to dictionaries sounds like a sly dig at our habit of quoting references when challenged on technical points. If so, there'll probably be opportunity for plenty more digs, because it's a very natural and reasonable thing to do.

But in this case I propose to raise no such defence. Our correspondent has made a very good point and one well worth watching in future.

It's reassuring to read his last part:

"As you do not often stray over the grammatical no-man's-land, I can only take a pot-shot very rarely. Still it's good fun: I have you won't take my strictures amiss."

To which I can only reply . . . "When I, or we, start taking offence at constructive criticism it will be time to step down for someone else."

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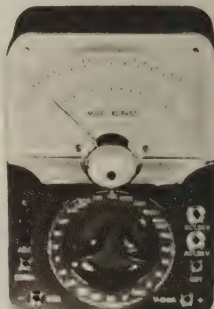
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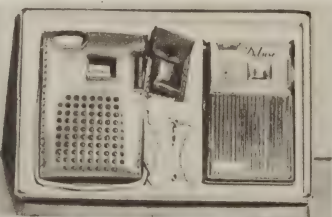
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the "Answer Man" Explains

TV Aerials and TV Sound

Our Answer Man, this month, has been called upon to discuss a couple of matters to do with television reception — the idea of stacking television aerials for distant reception and the problem of receiving hum-free TV sound signals on a wide-range FM broadcast tuner.

I have a book about television made easy. It mentions that better signals can be re-

ceived by stacking two aerials, with half a wavelength between them, and joining them with ribbon. How long is half a wavelength?

We don't know whether your phrase "television made easy" is the actual title of a book or a description.

Frankly, we are not at all happy about some of the books we have seen, which might qualify for such a description. In bypassing some of the "too hard" aspects, they can all too easily end up with half-truths, particularly if the author is more gifted as a writer than as a technician.

From what you say, we suspect that something like this applies to the book which you have been reading.

One of the accepted methods of intercepting a little more signal from distant television stations is to "stack" two aerials, mounting them one above the other and interconnecting them. But there follows from this statement questions as to how far apart they should be mounted and just how they should be interconnected.

The practice of mounting aerials a fraction of a wavelength apart is commonly advocated in handbooks on VHF aerials but a wavelength is not a fixed unit of distance, as you appear to imagine.

Radio signals travel through space at a speed of about 300,000,000 metres per second.

If a signal has a frequency of, say, 100 megacycles per second, it can be suggested that 100,000,000 complete wave cycles will pass a given point in one second.

From these two figures, it follows that the length of each wave in space must be 3 metres.

For a signal having a frequency of 200 megacycles per second, the wavelength would be 1.5 metres, and so on.

In short, the wavelength of a radio signal varies inversely with frequency.

Assuming that wavelength is expressed in metres and frequency in cycles per second, either one can be found by dividing the other into 300,000,000.

With wavelength in metres and frequency in kilocycles per second (KC) either can be found by dividing the other into 300,000.

For metres and megacycles per second (MC) use 300.

Where an aerial has to operate over a narrow and specific band of frequencies—say a single TV channel or the 144-148MC amateur band—no special difficulty arises, because the equivalent wavelength can be calculated, as also any fraction of a wavelength.

But general purpose television aerials are commonly designed and required to operate over a wide range of frequencies, from 50MC or below to over 200MC. The incoming signals may therefore have a wavelength ranging from more than 6 metres to less than 1.5 metres.

In these circumstances, the term "half a wavelength" is quite meaningless in terms of aerial spacing.

Nor does the problem end there. It isn't right just to connect two aerials together with a piece of aerial ribbon and expect them to work efficiently in unison.

As far as the end result is concerned, the exact nature and length of the interconnecting conductors is significant, as also the phasing (that is whether the elements one above the other are connected or those on opposite sides of the two aerials) and the point of connection for the down-lead.

The instruction you quote doesn't take

any of this into consideration and the results you might get by simply mounting two aerials, one above the other, and interconnecting them would be very much a matter of luck.

If you are in a weak signal area and have a need to use something more than a single high-performance aerial, you would be well advised to take the matter up with a TV aerial manufacturer or his local representative. They have worked out the right ways to stack various types of aerial and can provide the requisite "hardware" to interconnect them to best advantage.

Is the FM sound radiated by television stations the same kind of FM as used for

overseas hi-fi broadcasting? On an FM tuner, the sound seems to suffer from hum, even though I don't notice the same hum in my television receiver. Why?

This question really breaks up into two parts, so let's begin by considering the first sentence.

The frequency modulated (FM) sound signal radiated by Australian television stations differs only in detail from the kind of signal radiated by overseas FM broadcast stations — and by the experimental stations which once used to operate in this country.

The FM sound signal pertaining to a television station is handled by a fairly ordinary FM transmitter quite distinct from the picture transmitter but, for convenience, radiated from the same aerial system.

In terms of frequency, television stations are distributed in "channels" from below 50 to above 200MC and most of the signals, picture and sound, fall outside the normal pass-band of conventional FM broadcast tuners, as fitted to some imported hi-fi equipment.

In Australia, channels 3, 4 and 5 are inside the sector originally envisaged for FM broadcasting, but other channels may sometimes be received as an "image" or other "spurious" effect in tuners having limited RF selectivity.

Another point about FM signals, as transmitted from television stations, is that their frequency deviation is somewhat less than usual for FM broadcast stations, this being dictated by the technical standards under which TV stations operate.

This does not have any essential effect upon the quality of sound available but does mean that the detector in a tuner, designed for wider signal deviation, recovers a somewhat lower level of audio signal, requiring the audio gain to be advanced a little more.

However, while the sound signal transmitted by a television station is a fairly normal FM transmission, the method of



"What's it like now?"

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5Z4	10	0	CV66	7	6
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6S7	12	6	0Z4	7	6
6X5	7	6	CL4	12	6
7C5	5	0	7A6	12	6
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10A17	10	0	6A3	7	6
12A17	7	6	6C6	12	6
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1.25 mfd 6000v.	2	8
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0 2 mfd 2000v.	15	0
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0 1 mfd 1500v.	15	0
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reception adopted in modern television receivers is quite different from a conventional FM broadcast tuner.

In the latter, a normal dial is used, as in a medium-wave broadcast receiver, driving a ganged variable capacitor or a set of slugs in the coils. The tuning must be adjusted so that the local oscillator, beating with the incoming carrier, heterodynes it to the frequency of the IF channel, which usually operates at about 10.7MC.

For distortion-free reception, the resultant IF signal must coincide exactly with the band of frequencies over which the FM detector is set to operate. Mistuning can result in severe audio distortion.

This being the case, a conventional FM tuner calls for careful tuning in the first instance, added to which it must be designed to be as free from drift as possible. In some units, visual aids are provided to simplify tuning, or electrical circuits to compensate automatically for inaccurate tuning or subsequent frequency drift.

INTERCARRIER SYSTEM

In television receivers this problem is effectively disposed of by using what is called the "intercarrier" system of reception for the FM sound signal.

The standards make this possible, in the first instance, by insisting that all TV stations maintain an exact frequency spacing between their picture and sound carriers. In Australia, the figure set is 5.5MC, the sound carrier being set exactly 5.5MC higher in frequency than the picture carrier.

The input circuits of the receiver are kept wide enough in their pass-band to handle both signals simultaneously. Both are heterodyned to lower frequencies by the receiver's local oscillator and both pass through the IF channel to the video detector, still 5.5MC apart.

At the video detector, the IF signal relating to the picture is taken off for further amplification, so that it can modulate the picture-tube grid circuit.

The IF signal relating to the sound gets no further than the video detector.

In fact, the two IF resultants intermodulate at the video detector to produce a heterodyned or "beat" frequency at 5.5MC—the difference frequency between the two signals as originally transmitted and, later, as passed through the receiver's IF channel.

The 5.5MC resultant contains a mixture of the picture and sound modulation, as on the original carriers, though it is usual to control the amplitude of the two resultants at the video detector, such that the 5.5MC beat contains a predominance of sound modulation.

5.5MC IF SYSTEM

The 5.5MC signal is then passed through a separate IF amplifier, pretuned to 5.5MC, to an FM sound detector, which recovers the original audio modulation and substantially rejects the amplitude-modulated picture component.

The vital point behind all this is that the 5.5MC difference frequency, from which the FM component is ultimately resolved, is predetermined by the television transmitters and is the same for all channels. It is not affected by any tuning—or mistuning—at the receiver and therefore makes no demands upon the user of the television receiver.

At the receiver, the one vital require-



"He installed the yoke upside down, but is too lazy to change it."

"P. F. Reporter"

ment is that the discriminator coil for the FM detector be accurately pre-aligned to 5.5MC and that it be free from frequency drift from any cause.

Summing up then, the answer to the first part of the question is: "Yes, the FM signal radiated by television stations is a normal kind of FM transmission but television receivers employ a principle of reception different from ordinary FM broadcast tuners."

Now for the second part of the question regarding hum content.

On an FM tuner, the sound seems to suffer from hum, even though I don't notice

the same hum in my television receiver. Why?

Assuming no malfunction at the transmitting end, the FM signal radiated by a television station should be comparable

with that from a high fidelity FM broadcast station—given good program material, of course. There is no fundamental reason why the signal should contain any higher order of distortion, noise or hum.

More than likely, any hum you have heard is caused by a vestige of the 50-cycle field frequency on the adjacent picture carrier penetrating the FM tuner. It indicates some lack of selectivity on the part of the FM tuner and incomplete rejection of AM components. In all fairness, however, it must be admitted that the tuner is being asked to do something for which it was not originally intended—to resolve an FM signal cleanly, with a more powerful and deeply modulated AM signal sitting only 5.5MC away.

POSSIBLE CURES

It becomes a matter of chance whether or not a given FM tuner will meet the requirement. If it won't, it might be difficult to make it do so except by expert attention to its design and alignment.

On the other hand, it may be possible to improve matters by installing a TV-type attenuator in the aerial lead or a number of TV-type traps tuned to the offending sound carrier(s).

The FM sound system in television receivers has the advantage of being designed with this problem in mind but it would be wrong to assume that the problem doesn't exist in such receivers.

In many cases, the 50-cycle buzz is attenuated by the relatively poor bass response of ordinary loudspeaker systems, added to which is the tolerance that most viewers extend to hum or buzz that isn't too obvious.

It would be very much more obvious in a high-quality loudspeaker system and to a quality-conscious listener. Your own TV receiver may be good in this respect—or you just never have listened to its audio through the same loudspeaker as your FM tuner.

AUTO TYPE VOLTMETER

(From Page 31)

instruments is to used on a 6- or a 12-volt vehicle.

All that an intending user will need to do is mount the meter in a suitable place inside the vehicle and then run two leads through the bulkhead and on to the terminals of the battery, care being taken to maintain the correct polarity.

To mount these leads on the battery, we suggest drilling a small hole, say 1/8in in diameter, in the top of each battery post. The terminals on the leads can now be connected directly to the battery posts with two suitable self-tapping screws. For reasons explained earlier, readings may not be valid if the meter leads are attached to the cable connectors or elsewhere in the electrical system.

Because the meter has its multiplier resistor inbuilt, there is no possibility of accidental shorts in the wiring doing damage to the meter itself.

It is a good idea, however, to include a simple "line" type auto fuseholder with, say, a 100 milliamp fuse between the active post of the battery and the lead to the meter. This fuse should, for preference, be as near as possible to the battery terminal so that it gives maximum protection against any shorts

which may occur in the "hot" lead to the meter.

Included in this article is a voltage chart which shows typical normal and abnormal voltages that could be indicated on the meter under varying conditions of motor speed, etc. It must be remembered that these voltages are only approximate and intended as a rough guide. With experience, however, you will soon learn what is "normal" for your vehicle and deviations from the norm will stick out like the proverbial "sore thumb."

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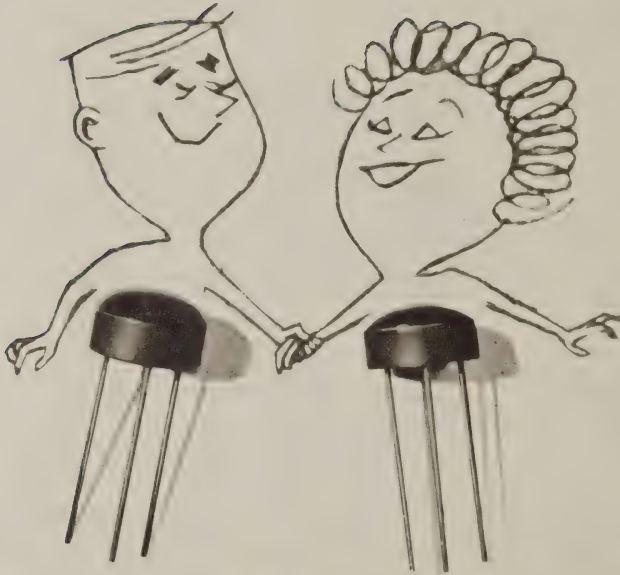
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2N 3638	PNP	T05 Epoxy	— 25V	65 @ 150mA, — 10V	— .25V	200Mc	8/3	5/6
2N 3643	NPN	T05 Epoxy	60V	220 @ 150mA, — 10V	— .22V	400Mc	9/6	6/6
2N 3638A	PNP	T05 Epoxy	— 25V	170 @ 150mA, — 10V	— .25V	200Mc	11/—	7/6
AY 1103	NPN	T05 Epoxy	30V	70 @ 250mA, — 1V	— 1.0V	250Mc	10/3	7/—
AY 1104	PNP	T05 Epoxy	— 30V	70 @ 250mA, — 1V	— 1.0V	200Mc	12/6	9/—
AY 1105	NPN	T05 Epoxy	20V	60 @ 250mA, — 1V	— 1.0V	250Mc	9/—	6/—
AY 1106	PNP	T05 Epoxy	— 20V	60 @ 250mA, — 1V	— 1.0V	200Mc	11/3	8/—
AY 6101	NPN	T05 Metal	45V	60 @ 150mA, — 10V	— .22V	400Mc	21/—	14/—
AY 6102	PNP	T05 Metal	— 40V	60 @ 150mA, — 10V	— .4V	200Mc	24/—	16/—
AY 6103	NPN	T018 Metal	12V	70 @ 10mA, — 10V	— .25V	800Mc	24/—	16/—
AY 6104	PNP	T018 Metal	— 6V	60 @ 10mA, — 10V	— .20V	700Mc	27/—	18/—

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PC 8

Silicon Transistors in Audio Circuits

With silicon transistors now available at low cost for home construction, it is natural for audio enthusiasts to be curious as to whether they can offer worthwhile advantages over the well-established germanium variety in preamps, output stages and other "difficult" applications in audio. Adapted from an application report published by Fairchild Australia, this article shows some of the advantages of the silicon transistor in designing a medium-power high-fidelity amplifier for record reproduction. A practical circuit and parts list are included.

TRANSISTOR audio amplifiers suitable for high quality gramophone reproduction were not a very attractive proposition until quite recently. Compared with high quality valve amplifiers they tended to be more costly, less versatile and less tolerant of adverse conditions. To arrive at a practical amplifier design the designer was virtually forced to compromise in terms of either quality or economy.

The recent release of silicon transistors for use in consumer products and for home construction has caused this situation to change. Using silicon transistors, it is possible to design a gramophone amplifier which is both economical to construct and capable of excellent performance.

The discussion and design details which follow should serve to illustrate the advantages which accompany the use of suitable silicon transistors in audio. The discussion starts with a consideration of the input circuitry.

Because of the low cost and highly acceptable performance of the crystal-ceramic type pickup cartridge, this type of cartridge is naturally the popular choice among designers of economy-conscious grams. With valve amplifiers, this type of cartridge is almost ideally compatible. It has a high amplitude output, requiring little if any preamplification; it has a virtually "flat" frequency characteristic, obviating the need for

equalisation to compensate for the gain loss and frequency unbalance produced by the mismatch, noise becomes a problem. And if we use feedback circuitry to increase the input impedance of the amplifier to produce correct matching, noise and temperature stability both become a problem.

At least, the latter is the case with germanium transistors; the silicon variety are much more helpful, as will be explained shortly.

It would be ideal to use an FET or MOS field-effect device in the input circuit, as such devices have an extremely high input impedance and very low noise. However, although these devices are now available locally for higher-priced industrial use, they are far from economical

milliamps.

Operation at low emitter current levels is thus an advantage, providing the current gain Beta can be maintained at low currents. This is not the case with most germanium or silicon transistors, but special silicon types such as the Fairchild SE4010, have very high Beta at currents of only 10uA, while some industrial types have a Beta of more than 100 at only 1uA (2N3117).

A feature which makes silicon transistors such as these particularly attractive is their very low collector-base leakage current, I_{cbo} . Due to their relatively high leakage, germanium transistors generally cannot be operated satisfactorily below about 300uA, even if the current gain could be maintained below this level.

In addition to the transistors, the input biasing resistors must be considered. Although with suitable feedback design these resistors can be "bootstrapped" so that their input shunting effect is considerably reduced, with germanium transistors the resistors must be moderately low in value.

Silicon transistors again score here because of their very low I_{cbo} and their ability to operate with high gain at low current levels. Using a silicon tran-



The circuit for this silicon transistor amplifier is given overleaf. Developed in the Fairchild Australia Pty. Ltd. Application Laboratory, it is built on a 3.1in x 4.1in wiring board with a length of 1in x 1in aluminium angle as a heat sink for the output transistors. The text discusses its performance.

where entertainment equipment is concerned. Thus a practical crystal-ceramic pickup input stage must use junction transistors, arranged to give similar results but at a reasonable cost.

The input impedance of a transistor depends upon current gain and feedback. The current gain depends both on the internal geometry of the transistor concerned and the emitter current, while the feedback may be both internal and external.

In common emitter configuration the input resistance for both silicon and germanium transistors is given by the product of current gain Beta (β) and the internal emitter resistance. The internal emitter resistance is given in turn by $25/I_e$, where I_e is the emitter current in

sistor the biasing resistors can be of a very high value, and with a bootstrap circuit their effect can be made negligible.

As mentioned above, a high input impedance can be achieved with many transistor types by using local or extended feedback. Many circuits using common collector configuration or variations of this configuration have in fact been in use for some time, but this is not the best solution where optimum noise performance is considered.

There are many low noise transistors available. However, few are available which give low noise when used with a high source impedance. In general, noise increases with source impedance, so that a transistor must be operated at a very

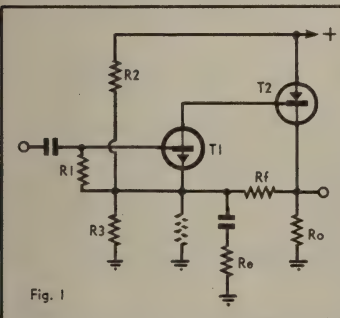


Fig. 1

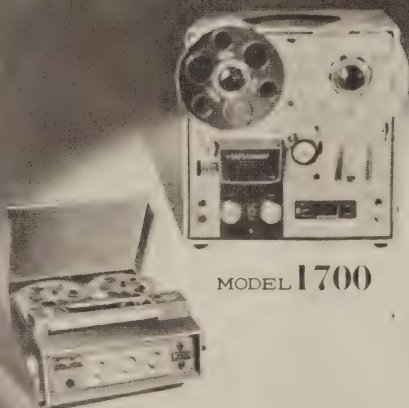
special equalisation, and its requirement of a high loading resistance is easily met by a valve input circuit.

When one tries to use the crystal or ceramic cartridge with transistor amplifiers, however, problems arise. The normal junction transistor is a current-operated device, and thus has inherently low input impedance.

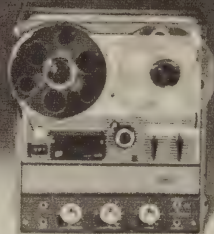
If we attempt to feed the pickup cartridge into a low impedance input and

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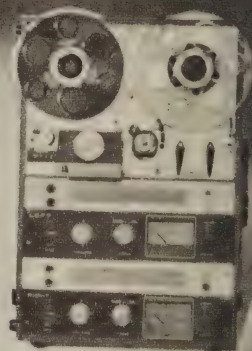
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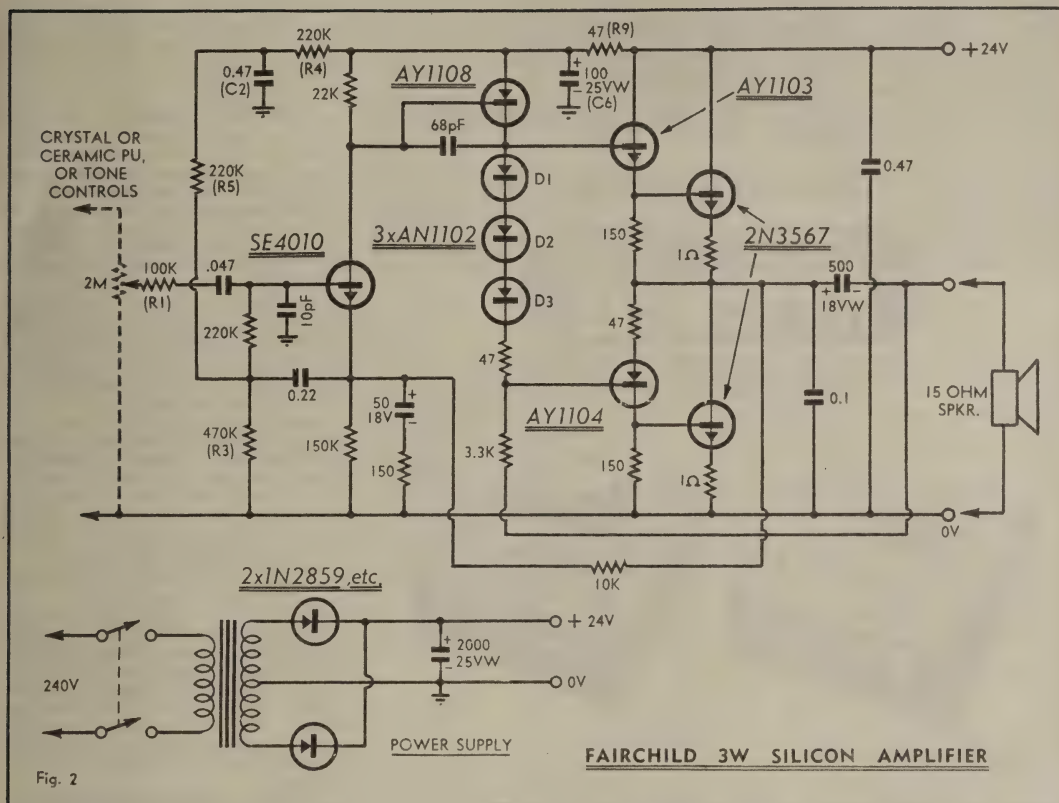


Fig. 2

The circuit for the amplifier shown on page 77, an example of the application of silicon transistors to audio circuitry.

low emitter current to give acceptable noise performance when fed from a high impedance source. Only a silicon transistor like the SE4010 is capable of meeting this requirement.

One component of transistor noise is due to collector-emitter leakage, which is a function of a collector voltage V_{ce} . With the older germanium transistors, leakage is high and thus the transistor must be operated with low applied V_{ce} if this component of noise is to be kept to a minimum. This is not a problem with silicon transistors due to their very low leakage.

While the use of a common collector ("emitter follower") input stage with its large unbypassed emitter resistor improves the input resistance of the stage at the expense of noise figure, external feedback to a small emitter resistor does not degrade the noise performance. Yet it increases input impedance considerably.

As far as the input stage is concerned, then, the best solution at present would seem to involve a low noise silicon transistor like the SE4010, in a low-current bootstrapped circuit to which overall negative feedback is applied via a small emitter resistor. This approach provides high input resistance with low noise, at quite reasonable cost.

These requirements can be met quite neatly by a feedback common emitter complementary pair. The basic circuit is shown in figure 1.

If we neglect the effects of R_1 and

PARTS LIST

TRANSISTORS AND DIODES

- 1 SE4010 or equivalent.
- 1 AY1108 or equivalent.
- 1 AY1103 or equivalent.
- 1 AY1104 or equivalent.
- 2 2N3567 or equivalent.
- 3 AN1102 or equivalent.

RESISTORS.

Half-watt, 10%: 3 x 47 ohms, 3 x 150 ohms, 3.3K, 10K, 22K, 100K, 150K, 220K.

Half-watt, 5%: 2 x 220K, 470K.
One-watt, 10%: 2 x 1 ohm.

CAPACITORS.

Ceramic: 10pF, 68pF, 0.47uF, 0.1uF, 0.22uF, 2 x 0.47uF.

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Load Resistance Ohms	40	15	15	15	3	8
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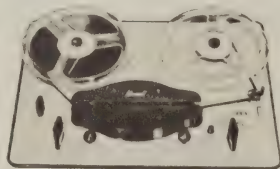
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R2/R3, and also the collector-base feedback resistance of the transistors, input resistance, voltage gain and output resistance are given by

$$R_{in} = \beta_1 \beta_2 R_{eR_o} / R_f$$

$$A_v = R_f / R_e$$

$$R_{out} = R_f R_s / \beta_1 \beta_2 R_e$$

So the input impedance is high, the output impedance is low and the gain is virtually independent of transistor parameters. (R_s is the source resistance.)

In the more general case where there are more stages inside the feedback loop, β_2 can be replaced by a total following gain factor K , equal to the product of the stage current gains.

The circuit of figure 1 can be extended into a complete amplifier by the addition of complementary and/or quasi complementary output circuits. The complete circuit for such an amplifier is given in figure 2. The remainder of this circuit will now be discussed.

Distortion is kept at a very low level as the output transistors are operating in the common collector configuration. Driver distortion is reduced by the use of a silicon transistor, because with such a transistor there is no Icbo problem and we can operate it from the constant current source in linear drive. This is in contrast with a germanium driver stage, which would have to be driven from a constant voltage source.

In addition a large amount of negative feedback is applied. This is possible as the transistors are very high frequency types and have negligible phase shift over the audio range. Again, no transformers are used, and this improves distortion. The total harmonic distortion can be kept below 1 per cent quite easily without the need for matching of output transistors.

A further design advantage incurred with the use of large amounts of feedback is that resistor values are relatively non critical, except for the bias determining components. Thus costs can be kept down by the use of wider tolerance resistors.

In this type of circuit, the centre voltage of the output pair should be only slightly below half the supply voltage in order to obtain maximum output. This is easy to achieve and maintain by suitable choice of resistors R3, R4 and R5 (5 per cent types).

Under these conditions nearly complete DC feedback is applied, and as Icbo and base to emitter voltage variation in the first transistor are insignificant, stability is maintained when temperature or supply voltage changes.

Apart from the stability of the output stage centre point, the design must guard against the possibility of thermal runaway of the output transistors. For complete thermal stability three compensating diodes D1, D2 and D3 are used, and these should be placed in close thermal proximity to the output transistors.

It is also important to use heat sinks where higher power is required, and biasing close to class B is desirable. The use of thermistors to bias complementary output stages is not recommended, since the impedance of the bias line may then be high enough to cause line to line signal current and reduce thermal stability.

Hum and microphony are virtually non-existent. Transistors are free from microphony and are themselves free from hum. In this design two filter sections R9/C6 and R4/C2 have been included, and this is quite sufficient to reduce circuit hum to a very low level.

The upper output transistor has its

collector connected directly to the supply, but as it is connected in common emitter filtering of the base supply is all that is required to prevent hum reaching the speaker. Of course the layout of the circuit should be carefully planned to prevent hum introduction into the input circuitry. The printed wiring board shown exhibits no problems in this regard.

Although the circuit uses only very high frequency transistors, some AC stability problems can arise, usually due to layout. It should be realised that the input impedance of the amplifier is in the order of several megohms, and therefore capacitive coupling from the output circuitry can cause instability.

On the low frequency side, care must be taken in selecting RC time constants. In the circuit of figure 2 the resistor R1 has been added to eliminate the effect of the volume control.

Occasionally other parts may have to be added to improve the stability, such as a small capacitor from input to ground or across the feedback system. As the speaker may also be highly inductive at high frequencies it may be necessary to fit it with an RC shunt circuit.

The quoted performance of this amplifier when fed into a 15 ohm load is as follows: Maximum power output for 5 per cent T.H.D. is greater than 3 watts, with an input sensitivity for 3 watts output of 105mV. Frequency response between 3dB down points, 24cps to 25KC. Total harmonic distortion at 1.4 watts output is 0.6 per cent, at 100cps, 1KC and 10KC.

Signal to noise ratio, using 3.2 watts output as reference, is quoted at 57dB for open circuit input and 69dB for shorted input. Current drain at 3.2 watts is 208mA, and for no signal 8mA at 25 degrees C. (10mA at 50 degrees). Input impedance is quoted as better than 2M.

(These figures were checked in the "Electronics Australia" laboratory, using the sample amplifier pictured, and the performance was found to be substantially as claimed. Small deviations were noted in the case of power output and low frequency response — the sample would deliver only 2.6W before clipping and had a lower corner frequency (—3dB) of 40cps rather than 24cps. Noise, distortion and sensitivity were virtually as claimed; the input impedance was slightly over 4M).

It is thus fairly clear that silicon transistors offer definite advantages in the field of high-quality audio. We may expect to see them used more and more in this field, with a corresponding improvement in the performance, cost, versatility and reliability of transistorised audio equipment.

The application report from which this article was adapted was written by M. Somogyi and C. J. Henry, being designated APP-A-4. In addition to the 3W amplifier shown the report gives details of a 5W version, while an addendum gives details of a 2W version using only four transistors.

Designers interested in obtaining the report and addendum or further details regarding the silicon transistors could do so by writing on company letterhead to the Applications Laboratory, Fairchild Australia, 46 Caroline Street, South Yarra, Victoria.

(Editorial Note: We understand that printed wiring boards for this amplifier will soon be available from R.C.S. Radio Pty. Ltd., of 651 Forest Road, Bexley, N.S.W.)

Newest Report from— "Audio and Record Review" (U.K.) HEAPS ADDITIONAL PRAISE ON ADC CARTRIDGES

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Our September 1964 issue carried a very favourable report on the ADC Point Four E cartridge, as well as the Pritchard ADC-40 pickup arm. Extended

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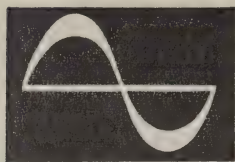
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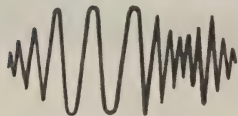


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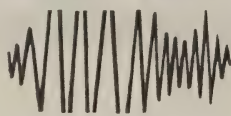
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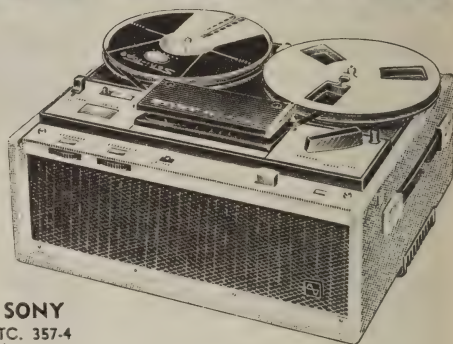
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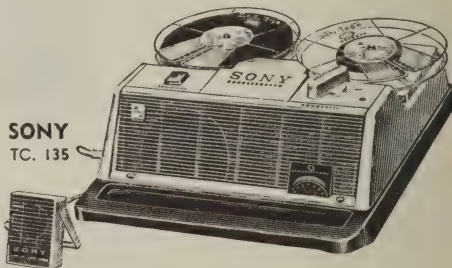
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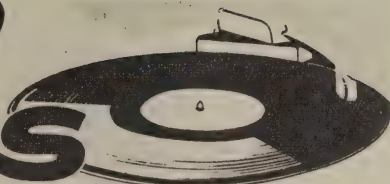
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Recording a Jazz Convention

"Recorded live" or "Recorded on stage" are simple enough words when they appear on the jacket of an L.P. album but they can hide some headaches — and heartaches — for those responsible for making them in the first instance. This is a brief diary of two engineers charged with the responsibility of recording the last Melbourne Jazz Convention.

By W. E. Hawtin & T. G. Corbett*

EARLY in November 1963 we were awarded the task of recording the entire proceedings of the 18th Australian Jazz Convention to be held in Melbourne between December 26th and 30th 1963. The convention is an annual event and is held in a different city of Australia each year, attracting musicians from all States and vast audiences.

The convention is recorded for the twofold purpose of providing participating musicians with recordings of the performances and for the archives of the organising committee. The program of the convention involved 25 hours of recording time compressed into a period of four days.

Venue for the convention was the Kew Civic Centre, Victoria, and our opening move was to inspect the building to determine the best place for equipment and personnel. The Kew Civic Centre has a well designed auditorium seating about 2,000 people and with a large well-draped stage having plenty of space in the wings.

A second auditorium seating about 500 people is available and, by opening a double layer of folding doors, this second auditorium can be joined with the main auditorium. An elaborate sound reinforcement system is installed and, in view of this, it was decided to take a split from the recording equipment to feed the sound system. This permitted the use of one microphone plot only to save the musicians from stumbling around in a forest of microphones.

As adequate off-stage space was available we decided to locate the mixing console, associated equipment and tape recorders together on one side of the stage, allowing an excellent view of the proceedings and easy access to the stage for rearrangement of microphones. Five microphones were used as follows:—

Two AKG type C28A condensers, 1 miniature Neuman condenser, an AKG type D12 dynamic and a Shure type M55 dynamic. All of these microphones were of, or were set to, a cardioid pick-up pattern. In the nominal "standard" set-up the first three microphones were spaced along the apron of the stage to accommodate the "front line" of a typical "traditional" jazz band, usually comprising trumpet, trombone and clarinet.

* east Recording Company, 10 Elm Avenue, Elsternwick, Victoria, Aust.

The other two microphones held a roving commission and were placed to pick up the rhythm section, usually drums, banjo and string bass. Needless to say this arrangement was not always adhered to. Some groups used a piano and, in this case, the D-12 was placed on a short stand behind the piano (an upright) towards the "treble" end of the sounding board.

It was sometimes necessary to bring one of the condenser microphones back into the rhythm section. The five microphones were fed to a seven channel mixer of our own design. Two Rola tape recorders, type 66, operating at 7½ IPS full track were used.

The recorders were fed from the mixer via a resistance splitting network, allowing fading from one recorder to the other without any loss of signal or audible effects in the public address system.

Pioneer earphones were used for monitoring or "balancing" the performers. It was also possible to use the built-in monitor speakers of the recorders without feedback.

To cater for enthusiastic performers and their entourages a further recorder feeding a speaker enclosure was installed in a dressing-room under-stage for playback purposes.

Long-play tape on 7in reels was selected for recording, giving 45 minutes time per recorder before changeover was necessary. This allowed the stand-by recorder to be switched off to permit cooling, as the ambient temperatures encountered in the hall in Melbourne's summer were extremely high and, even after 45 minutes, the recorders became incredibly hot. However no ill effects resulted from these conditions, other than to ourselves!

As the items recorded ranged from solo performances to 15-piece (or more) brass bands, considerable microphone rearrangement was necessary throughout the proceedings. Generally each group of musicians performed for a 30-minute period and thus large-scale microphone movement was normally only made in preparation for each group.

Adjustment of the sound system level was necessary from time to time complicated by the rather incongruous location of the sound system equipment rack in the front office of the hall. In any case it was necessary to go into the audi-

torium at intervals to determine if the level was sufficient for the audience, which varied in number and noise output almost as much, and as frequently, as the performers!

Needless to say all was not plain sailing and various problems arose. The principal one of these was the total ignorance displayed by a major percentage of the musicians in the use of microphones, who fell into one or more of the following categories:

(a) The "fiddler," who feels compelled to adjust the microphone continuously whilst performing. The resulting effects were dramatic, to say the least, particularly in the case of the Neuman microphone which had a ring switch for altering its pick-up pattern characteristics. Thus the ardent "fiddler," usually managed to change its cardioid setting to an omnidirectional setting with a resulting earth-shattering roar of feedback from the sound system!

(b) The "blaster," or "I will be heard" type who considers that microphones are merely a pipe to the speakers which must be shouted down to convey intelligence to his ecstatic audience.

(c) The "mover," who thinks that a microphone must be moved where he wants it and, even if the stand was nailed to the floor, would valiantly strive to move it to where he considered it should be.

(d) The "aggressive" type who apparently doesn't see the microphones and walks through them, assaults them with assorted instruments and generally creates the impression that he will not be dictated to by all these "sticks" on the stage.

(e) The "shy" type who wouldn't go near a microphone for quids.

Despite all these fellows, who appeared in abundance, we are still reasonably well balanced mentally and no fisticuffs were resorted to.

Several technical faults in the equipment arose, the first being a BUZZ in the sound reinforcement system which appeared during the second day. This was finally traced to a cable fault in the permanent lines which, inevitably, were inaccessibly located below the stage! It was ultimately cured by vigorously slamming a footlight trapdoor (a perfect example of Thump's Law).

On the third day the gain control on one of the recorders became scratchy and several tapes were slightly marred as a result of this.

Despite all these problems the general standard of the recordings on playback proved to be extremely high, in many cases close to studio quality and even the Press commented on the high standard of the sound reinforcement. We now have 30 reels of long-play tape full of good Australian Jazz, a lot of valuable "know-how" and a smug smile of satisfaction.

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Classical reviews

By RAMSAY PENNICUICK

BELLINI, *I Puritani* — Highlights

BELLINI, *I Puritani* Highlights.
 Elvira: Joan Sutherland, Gualtiero
 Valton: Giovanni Foiani, Giorgio
 Valton: Ezio Flagello, Riccardi:
 Renato Capecchi, Arturo Talbo:
 Pierre Duval, Enrichetta, Marg-
 retta Elkins, Chorus and Orchestra
 of the Magio Musicale Fiorentino.
 Conducted by Richard Bonyngne.
 Decca, Mono LXTA 6154, Stereo
 SXLA 6154.

This is one of the works which Miss Sutherland is to perform during her forthcoming opera season and it really is rather a depressing prospect to contemplate. It was the composer's last work and has never been satisfactory. Most people blame the libretto which is certainly muddled and is based on Walter Scott's novel "Old Mortality." The story is reasonably satisfactory but the arrangement of the acts and the sequence of the numbers most ineffective.

One has to compare it with Donizetti's *Lucia*, which is similar in many ways, except that *Lucia* only goes mad once while it becomes almost a habit with the heroine of *Puritani*.

However, a good deal of the trouble lies in the music. Qui la voce is certainly one of the most beautiful melodies ever written for a soprano voice. The bass solo *Cinta la Fiori* is excellent and the whole of the tenor part is rewarding but there are long stretches that are very humdrum. Many of these dull passages are missed in the highlights.

Miss Sutherland's singing of Elvira displays all her good as well as her bad points. The chief of the latter is her inability to pronounce any words on high notes and her habit of sliding on to notes. Against these faults must be placed her dazzling singing of the coloratura passages and the many ornaments and variations with which she decorates the music. These latter are said to be the work of Mr Bonyngne and are always in excellent taste.

The tenor, Paul Duval, who is said to be a French Canadian, has a powerful singing voice but displays little variety of tone. He dodges the top F but sings several brilliant Ds. Neither Flagello the bass, nor Capecchi the baritone is very distinguished. Richard Bonyngne conducts in an alert musical fashion and the chorus and orchestra are satisfactory. The recording is very clear.

★ ★ ★

BEETHOVEN, Piano Concerto No. 4 in D major, op. 58. Emil Gilels, pianist and the Philharmonia Orchestra. Conductor: Leopold Ludwig. World Record Club. Stereo TE/252.

The first performance of Beethoven's Fourth Piano Concerto was an epoch making event in the history of music. Concertos had always begun with a long tutti for the orchestra in which all the material for the first movement was an-

nounced; then the soloist entered, generally playing something that had been heard already. Beethoven completely changed this in his Fourth Concerto.

The work begins with the piano playing the main theme of the first movement very simply and quietly. Then follows the tutti in which the rest of the themes for the movement are heard. The piano part is of the utmost brilliance but it is generally occupied in commenting on what the orchestra has said.

The second movement is a dialogue between the piano and the orchestra. The orchestral part is stormy, the piano part consisting of smooth quiet playing. Gradually the solo part asserts itself and the orchestra accepts the situation.

The last movement is a light frivolous rondo which seems a strange contrast to the grave movement which has preceded it but seems to be inevitably right. Once again, the piano part is of the utmost brilliance, alternating with passages of great delicacy.

I have heard Gilels once before, in a Rachmaninoff concerto when I thought he displayed a dazzling technique but a rather hard tone. This recording proves that judgment quite incorrect. His technique is still dazzling but he plays with the utmost sympathy and his tone is of beautiful quality. The cadenzas in the first and third movements are by Beethoven and fit perfectly into the picture. Ludwig and the Philharmonia Orchestra provide an excellent accompaniment.

The recording can be strongly recommended.

★ ★ ★

RICHARD STRAUSS. Scenes from The Woman without a Shadow. The Emperor: Jess Thomas. **The Empress:** Ingrid Bjoner. **The Nurse:** Martha Moedl. **The Heavenly Messenger:** Hans Hotter. **Barak, the Dyer:** Dietrich Fischer-Dieskau. **His Wife:** Inge Borkh. **Choir and Orchestra of the Bavarian State Opera.** Conductor: Joseph Keilberth. D.G.G. Stereo 136422.

These scenes are taken from the recording of the complete opera *Die Frau ohne Schatten* which was performed at the opening of the rebuilt Munich Opera House.

The work contains some of the composer's best music but the libretto by Hugo von Hofmannsthal is incredibly involved and full of symbolism. Consequently it is seldom performed on the stage and the recording of the complete work is almost impossible to follow. For this reason the issuing of certain of the scenes was an excellent idea. The first scene is devoted to the Nurse and the Heavenly Messenger and it, unfortunately, must be admitted that Moedl and Hotter are not in good voice. Moedl, formerly a wonderful mezzo has hardly a steady note left. However, the next scene with the Emperor and the

Empress, contains some splendid singing. Jess is the young American Helden tenor and he certainly shows no fear of high notes; nor does Ingrid Bjoner.

But the outstanding feature of the work is the singing of Fischer-Dieskau and Inge Borkh. Barak's part in the duet in the third act is incredibly moving and was considered to be the highlight of the performance. Fischer-Dieskau is certainly the greatest living singer. No one else has such intensity. Considering that it was taken at the performance, the recording is extremely good.

The opera was first produced in Vienna in 1919, but as I have said, is very seldom performed anywhere. The music is most tuneful and wonderfully scored and I would advise any Strauss lover to buy this record, which gives a very good synopsis of the complete work.

★ ★ ★

ROSSINI, Overtures: La Cenerentola. Tancredi. La Gazza Ladra. Semiramide. Guglielmo Tell. Philharmonia Orchestra. Conductor: Carlo Mario Giulini. Columbia. Mono 330CX 1919. Stereo SAXO 2160.

Just as Rossini's operas are part of the repertoire of most opera houses, his overtures are always included in the list of works played by all famous orchestras. *Cenerentola*, which is based on the well-known fairy-tale of Cinderella is unusual in that its heroine is a coloratura mezzo. Rossini wrote the whole opera in 24 days but it must be admitted he took the overture from an unsuccessful opera of the previous year. Unlike most of his operas, the overture has some thematic relationship with the opera that follows.

Tancredi was Rossini's first real triumph and the work is based on Tasso's *Jerusalem Delivered*. It was the composer's first "Opera seria" though that would hardly be guessed from the sparkle of the music and the usual calculated crescendo.

Gazza Ladra was produced in Milan in 1817 and the composer had deliberately set out to impress the Milanese who had, so far, remained indifferent to his work. It is the first work the composer wrote for a large orchestra and it must be admitted it is a great improvement on the earlier works in this form, both in its themes and in its variety of orchestral colour. It has remained one of his most popular overtures.

Semiramide was another "Opera seria" based on a tragedy by Voltaire. It begins with a splendid example of writing for a horn quartet but in general does not suggest the tragic Babylonian story.

In fact, the chief theme is one of pure liveness, although it is said to accompany a solemn scene in the opera.

Guglielmo Tell was the composer's last opera. It was produced in Paris in 1829. If one compares this overture to any of his previous works, one immediately sees how the composer has developed and advanced since he wrote *Semiramide* six years previously. It is a masterly tone picture in four distinct sections and is one of the works which brought the cor anglais into orchestral prominence. The final thrilling gallop represents the rising of the Swiss patriots against their Austrian overlords.

Giulini is an Italian conductor who has won great praise for his concert as well as his operatic performances. Early in his career one of his performances was heard on the air by Toscanini, who helped him greatly, and his performance

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of the Verdi Requiem is considered quite outstanding. His performances are always full of life but he also pays great attention to all details and this is well demonstrated in the playing of these overtures. The Philharmonia Orchestra responds to all his demands and the recording is excellent.

★ ★ ★
FAURE. — Piano Quartet No. 2 in G Minor, Op. 45. Piano Trio in D Minor, Op. 120. J. Pasquier: Violin. P. Pasquier: Viola. E. Pasquier: Cello. Jean Doyen: Piano, World Record Club. Stereo, 6156.

Gabriel Faure was born in 1845. In 1856 he was appointed Professor of Composition at the Conservatoire where one of his most distinguished and devoted pupils was Maurice Ravel. It has often been thought that Faure is the last of the great French traditional composers, more human than the brilliant Ravel, more sane though less original than Debussy and always completely French.

For this reason he has had his greatest success as a song writer. He seems to understand the mentality of the French poets and sets their words in a most sensitive manner. One of his best known works is his Requiem.

The Piano Quartet and the Piano Trio are both delightful works, beautifully written and full of haunting melodies.

Unfortunately, on this recording, they are recorded at such a low level that it is impossible to criticise them adequately. I know nothing about the Pasquier Trio but they sounded most of the time as if they were playing with mutes, particularly the violinist. I was quite disconcerted near the end of the slow movement of the Quartet when I suddenly read "Mettez la sourdine." I could not hear that it made the slightest difference. The pianist struggled bravely but he could do little to clear the vague misty sound.

It was a pity, as both works are full of charming music.

★ ★ ★
Heifetz-Piatigorsky Concerts, vol. 3, with Jacob Lateiner and guests. Beethoven: Trio, op. 1, No. 1. Haydn: Divertimento for cello and orchestra. Rozsa: Tema con variazioni for violin, cello and orchestra. R.C.A. Stereo ZSC 2770 (available also in mono.).

It certainly sounds rather courageous for a 23-year-old composer to select for his introduction to the musical world of Vienna a set of three trios. These works were dedicated to Prince Lichnowsky at whose house the works were first performed.

We have already told the history of these recordings. The present record begins with Beethoven's first trio and the violinist and cellist are joined by Jacob Lateiner in this performance. Lateiner has toured Australia for the A.B.C. and was not regarded as much more than a completely competent pianist. However, in this performance, he shows himself as an excellent chamber music player and the charming work is played with good style and élan.

The second work has a curious history. The baryton is now a completely obsolete instrument but Haydn wrote no less than 149 compositions for it, the reason being that his patron Prince Esterházy was a competent performer on it. It was a close relation of the viola da

gamba. Some years ago Piatigorsky arranged some of these works for cello and piano and in 1965 the cellist asked Ingolf Dahl to orchestrate three of these movements to form a little concerto for cello and orchestra. The result is a charming work in which the superb tone of the cellist is splendidly displayed.

Miklos Rozsa is well known as a composer of most successful film music. Heifetz and Piatigorsky commissioned him to write a double concerto for violin and cello and the present work is the second movement of the concerto. It consists of a Hungarian sounding theme and seven variations and, although excellently written for the solo instruments, is on rather a lower plane than the other works.

The recording throughout is excellent and the record can be highly recommended.

★ ★ ★
BEETHOVEN, Highlights from Fidelio. Leonora: Christa Ludwig. Florestan: Jon Vickers. Rocco: Gottlob Frick. Don Pizarro: Walter Berry. Marzelline: Ingeborg Hallstein. Jaqueline: Gerhard Unger. First Prisoner: Kurt Wehofschtz. Second Prisoner: Raymond Wolansky. The Philharmonia Orchestra. The Philharmonia Chorus. Conductor: Otto Klemperer. Columbia. Mono 330CX 1907, Stereo SAX02547.

One is always most distressed when one reads of a most successful mezzo turning herself into a soprano. There is the case of Martha Moedl who was unrivalled as Klytemnestra and as Kundry. She was determined to be a soprano and sang Fidelio very badly at the opening of the rebuilt Vienna Opera and also Brunhilde in the Walkure recording made by Furtwaengler. She has now had to revert to the mezzo parts and her voice is completely unsteady.

Christa Ludwig has had a most successful career as a mezzo and now has turned her attention to the soprano parts. It must be admitted that she sounds like a soprano and the very testing part of Leonora does not appear to worry her, but alas only time can tell.

I do not care for operas with spoken dialogue and it is only near the end of this record that one hears any speech. The excerpts have been well chosen and the cast is excellent.

Vickers is certainly one of the best dramatic tenors living and on this occasion he sings with ringing tone and excellent clarity of diction. Pizarro does not have much to do in this selection but Berry is most convincing and all the parts are well sung. The Prisoners' Chorus is very moving and the duet at the end when husband and wife are united brings the work to a thrilling close.

The Philharmonia Orchestra plays most satisfactorily but I rather think that some of Klemperer's tempi are a little slow.

★ ★ ★
Music for voice and guitar. Peter Pears and Julian Bream, R.C.A. Stereo LSC-2718. Available also in Mono.

Peter Pears is a tenor particularly associated with the works of Benjamin Britten. Julian Bream is an English guitarist and lutenist who has been received with acclamation in every country in which he has appeared.

Most of the songs in this record have been written expressly for these two musicians and the works performed are

by four contemporary composers. It must be admitted at once that the outstanding writer represented is Britten for, not only does he know every trick of song writing, but his guitar parts are laid out for the instrument in the most brilliant manner. Bream is a masterly guitar player and Pears has never been in better voice.

Britten's first group consists of Songs from the Chinese, op. 58. These six songs are of very varied moods but the two guitarists are completely au fait with every nuance of the satirical texts. The first one, "The Big Chariot," at once informs the listener of the remarkable skill of the composer in adapting himself to this particular medium and the final "Dance Song" is amazing.

Then follows a group of British folk songs arranged by Britten and the second one, "The shooting of his dear" is perhaps the outstanding one; once again the writing is masterly in every respect. The second Lute Song of the Earl of Essex from Britten's Gloriana reminds one of the curious neglect that this opera receives.

William Walton is represented by a song cycle "Anon in Love" but, although excellently performed, it has an air of artificiality about it.

The Four French Songs arranged by Matyas Seiber are charming but they do not exploit the special features of the guitar. The recital ends with Racine Fricker's setting of "O Mistress Mine" but I did not think this particularly successful.

The recording throughout is excellent and the unusual music is performed with the greatest skill.

★ ★ ★
BEETHOVEN, Symphony No. 6 in F major (The Pastoral), London Symphony Orchestra. Conductor: Josef Krips. World Record Club. Stereo TE/336.

In our last issue we reviewed a performance of this work by the Vienna Philharmonic, conducted by Monteux.

We then expressed the opinion that this was probably the first example of "program music" and wondered why composers like Berlioz and Liszt had been condemned for writing in such a manner.

The cover note on the present record states that when Beethoven was asked

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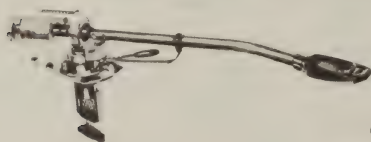
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this very question he refused to comment. "The hearer must find out the situations for himself, for this symphony is more an expression of feeling than of painting" he wrote. The cover note goes on to state that the work was possibly inspired by an earlier work of an obscure composer Justin Knecht (1758-1817) whose "Musical portrait of Nature" has subtitles for each movement which bear a striking resemblance to those of the Sixth.

Krips is a notable conductor but his ideas are very different from those of Monteux. The performance of the London Symphony Orchestra is extremely good but the listener must decide for himself which interpretation he prefers.

★ ★ ★

The Sons of Bach. Vol. 1. Johann Christian: Symphony No. 2 in E flat major, op. 9. Wilhelm Fried-
man: Symphony in D minor for flute, oboe and strings. Carl Philipp Emanuel: Concerto in D minor for flute and strings. Pro Arte Chamber Orchestra, Munich. Kurt Redel, conductor. World Record Club. Mono 6154. Stereo S6154.

This charming record comprises works by three of Johann Sebastian Bach's sons. The first is a symphony in three movements scored for strings and two flutes.

Johann Christian was the youngest of Bach's sons and, because of his father's death in 1750, he did not receive the initial musical training enjoyed by his elder brothers. At the age of twenty he went to Italy to study in Bologna with Martini and the success he had there attracted the attention of Signora Mattei who ran the King's Theatre, London. She engaged Bach who arrived in England in 1762 and there enjoyed a great musical and social success. The playing of the work is completely satisfying.

The next work is a concerto for flute, oboe and strings by Wilhelm Friedman, who was the second child and eldest son of Johann Sebastian and Maria Barbara. After matriculating at Leipzig he was appointed to the Sophien-Kirche in Dresden and soon occupied an important position in the Saxon capital. He left Dresden and went to Halle but resigned his appointment in 1764 and led rather an aimless existence in the last twenty years of his life. He wrote five symphonies and, of these, only the present one is in the form of a French overture, that is a prelude and fugue.

The flute is played by Kurt Redel, the conductor of the orchestra, and the oboe by Claude Maisonneuve but these instruments are only heard in the charming prelude. The fugue for strings only is a work of great strength and conviction.

The third work is a concerto in D minor for flute and strings by Carl Philipp Emanuel who was the second son of Johann Sebastian and Maria Barbara. He became musical director in Hamburg where he died in 1755. As well as being regarded as the father of modern piano playing, he is the most prominent composer between the period of his father and Haydn. The concerto is in three movements. Redel proves to be an expert flautist as well as a most capable director of the orchestra. The last movement is particularly interesting, as it displays the modern sonata form of which the composer is thought to be the originator.

The works are excellently played and would give great pleasure to all people interested in the music of this period.

ELECTRONICS Australia, August, 1965

DOCUMENTARY RECORDS

Reviewed by Ellis Blain

"THE RED BADGE OF COURAGE," read by EDMOND O'BRIEN, Philips CAEDOM TC 1040 (Mono).

The book itself, by Stephen Crane, is an American classic. Esteemed critic H. L. Mencken maintains that modern American literature stems from it. The author was only twenty-three when he wrote it and an extract from R. G. Vosburgh's description of Crane at work on "The Red Badge," gives an indication of his style . . . "His daring phrases and short, intense descriptions pleased him greatly. They were studied out with much care and, after they had been trimmed and turned and changed to the final form, he would repeat them aloud and dwell on them lovingly. Impressionism was his faith. Impressionism, he said, was truth, and no man could be great who was not an impressionist."

It is largely this impressionism in the writing that makes the recording so successful. The writing lends itself to reading aloud and Edmond O'Brien makes the utmost of the powerful and emotional language in which the story abounds. It never flags; indeed climax follows climax with such remorseless intensity that there is a constant temptation at the first hearing to skip the pick-up on to hear what happens . . .

The story is concerned with the American Civil War and the fortunes of a youth who suffers the agonies of fear that must beset the normal man who faces death for the first time. The action is encompassed in only two days of battle, flight and renewed battle. Within this space of time, the young man experiences the horror of cowardice, recovery and ultimate triumph over his own fear. Yet the red badge of courage, his wound, he achieves not by heroism but by accident.

The concentration of the story into the confines of an L.P. record and the direction, by Howard O. Sackler, are both first class while the reading is exceptionally powerful.

LORD BOOTHBY AND LORD REITH, FACE TO FACE WITH JOHN FREEMAN. Pye Piccadilly Series FTF38503 (Mono).

The "Face To Face" television series is known and respected wherever it has been shown. In fact, it brought a new dimension to the technique of interviewing in any medium.

John Freeman has a mind which is the envy of his competitors in the field and his ability to draw his subjects, no matter how eminent or brilliant, is their despair. Invariably, he is so well informed about his interviewee that he appears, time and again, to catch him off guard. Yet, this is no trickery; he has merely done his homework. Freeman's integrity is never in question but deliberately he takes an opposing viewpoint or attitude with the result that the whole proceedings have much of the excitement and partisanship of a duel.

This interview with Lord Reith, ex-Chairman of the BBC, a giant of a man in every way, has even more than the

usual number of thrills and dramatic moments as Reith is almost brutally frank — often against himself sometimes in his defence. The whole half-hour is moving to a degree and the ultimate impression left with the viewer or listener is intensely personal.

The fascinating thing about Freeman is that he never descends to rudeness, he is never aggressive and he never asks a question that is in dubious taste. He appears quite unmoved even when his subjects step outside the ring and themselves resort to such tactics. But he is not cold or merely objective.

In a self-interview which I heard recently on the A.B.C., he refutes the suggestion that his interviewing is ruthless. But I am not so sure. And by no means the least interesting aspect of it all is the fact that the victims continue to come to the slaughter, doubtless motivated by the conviction that they alone will triumph where others have fared less well. But do they ever?

I hope I have given the impression that this record carries one of the great verbal encounters of our time, for that is my intention. Regrettably, the impact of the companion piece on the reverse is greatly lessened by unaccountably noisy and distorted sound. More's the pity as Boothby is a fascinating character, described in John Freeman's own words of the jacket in these words: "I think he is one of the most gifted and idealistic — and truthful — men anywhere in public life. I also think he's lazy, self-indulgent, vain and over-generous. All these qualities mixed up together have led to the comparative failure of his public career. And they've led to the total success of his personal friendships."

"ROBERT DONAT READS FAVORITE POETRY AT HOME," Argo Spoken Arts Series 848 (Mono).

After the illness which ultimately

destroyed him, had made it impossible for him to continue his successful career as an actor, Robert Donat found some solace in his tape-recorder. With the machine as audience and critic, he continued his striving for perfection, recording and re-recording until, at last, he was satisfied that he could do no better.

But, all the time, asthma was gaining upon him and, in these tracks, which were the last he made, the constantly increasing struggle for release from its physical grip is, at times, apparent in the fight for breath or against the ever-recurring need to cough. But these are minor and, to anyone who admired Donat, touchingly human aspects of an intensely human performance. The choice of poems, too, is personal, as is the manner of reading, for they were never intended for publication. But his son, John Donat, has made them available and we are the beneficiaries.

The recorded sound is no better or worse than is to be expected from the average home recorder not too expertly operated. But the interest is in the man who made them.

"A WORLD OF SEARCHING EYES," ALPHA AFM 013 (Mono).

Deliberately, I have omitted from the title the eye-catching name on the jacket, that of John Betjeman who chose the verse but who does not appear in any other capacity. Frankly, I cannot see that the verse is made better or worse by being selected by this authority or that and, certainly, none of it bears the least resemblance to Betjeman's own work.

Of the material on the record one can say only that it is subject to the pleasures and faults common to most attempts at poetry by children. As entertainment, per se, it is negligible except to anyone who has a professional interest in such matters. From the point of view of the Australian listener, too, the sometimes quite marked regional English accents of the children who read — incidentally, not the children who wrote — must lessen the appeal of the record.

Despite these criticisms, teachers and others with a special interest in the subject may find this experiment both interesting and valuable. Recorded sound is good.

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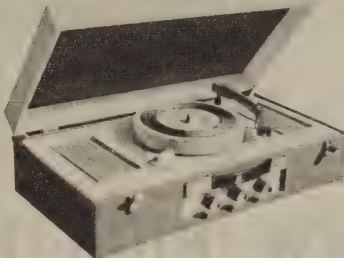
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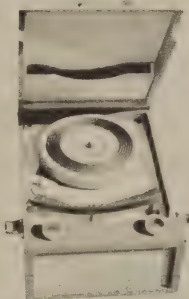


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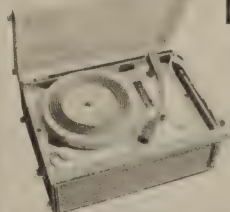
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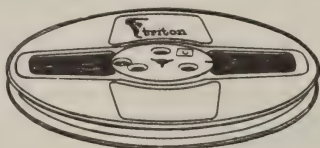
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Interest: Gospel songs.
Performance: Very good.
Quality: Excellent.
Stereo: Excellent spread.

Most people interested in Gospel broadcasting — and probably many who aren't — have become familiar with "The Old Fashioned Revival Hour" conducted by Dr and Mrs Fuller. From a single radio station in 1925, it has gradually built into a world-wide coverage.

This imported American pressing contains some of the Gospel songs which have become favourites with listeners to the session. Being intended to fit in with the various moods of the session, and to lend variety, the tempos differ widely but all are very well presented and make good listening:

"Chorus Medley," "No One Ever Cared For Me Like Jesus," "To God Be The Glory," "No, Not One," "Fire Song," "O For a Thousand Tongues," "By And By, When Morning Comes," "Hiding In His Love," "Where Could I Go," "Sweet By And By," "It May Be Today," "Thou Mighty To Save."

In terms of technical quality, the disc is excellent . . . smooth, wide-range sound, no background and with well spread stereo. Recommended. (From Southwell Supplies, 176 Geelong Rd., Footscray, W.II, Victoria). — W.N.W.

★ ★ ★

FRED WARING, THE PENNSYLVANIANS And The Waring Chapel Choir. Mono, Universal Record Club UM-658.

Interest: Sacred Easter songs.
Performance: Might have been good.
Quality: Poor.

This record is an escapee from the Easter season but it wouldn't have mattered much had it not reappeared!

According to the jacket notes, it is intended as a companion disc to Fred Waring's "Song of Christmas" but, whatever merits it might have had, have been let down by the recording itself, at least as interpreted by my compatible stereo magnetic pickup. The sound is lacking both in response and dynamic range and punctuated with spasms of tracing distortion.

On side 1, Fred Waring narrates "The Song Of Easter," the Easter story woven around 14 Negro spirituals. This is followed by "Ave Maria," "Holy, Holy, Holy," "The Holy City," "The Palms," "Before The Crucifix," "When I Survey The Wondrous Cross," "O Day Of Rest And Gladness."

A disappointment. (W.N.W.)

FROM STAGE AND SCREEN

SONGS TO SHAKESPEARE PLAYS—

T. A. Arne, Maureen Forrester, alto, Alexander Young, tenor, Martin Isepp, harpsichord, with the Vienna Academy Chamber Choir and the Vienna Radio Orchestra conducted by Brian Priestman. Westminster 12-inch stereo, SWC-931,560. Also in mono on WC-31,560.

Interest: Shakespearean song.
Performance: Sensitive.
Recording: Low level but good.
Stereo Quality: Good.

For Shakespeare lovers, a recording of Arne's settings of some twelve songs from the plays. The soloists are Maureen Forrester, famous Canadian alto, and English tenor Alexander Young—well known for his operatic and oratorio singing at Glyndebourne, Covent Garden and Sadler's Wells. They are backed in bright but fairly standard fashion by the Vienna Radio Orchestra conducted by Brian Priestman.

The pieces performed are "Where The Bee Sucks," "Come Away, Death," "The Cuckoo Song," "Blow, Blow, Thine Winter Wind," "Sigh No More Ladies," "Under The Greenwood Tree," "Soft

Flowing Avon," "Tell Me Where Is Fancy Bred?" "The Owl," "Come Unto These Yellow Sands," "Dirge In Cymbeline," "Behold Your Faithful Ere You Can Say," "Come Away, Death" (second version), "Sweetest Bard," and "Solemn Dirge." The last-named is sung by the Vienna Academy Chamber Choir.

The recording quality is quite good, although it is recorded at a low level—which tends to degrade the signal-to-noise ratio somewhat.

Recommended, for Shakespeare lovers and English tunes. (J.R.)

★ ★ ★

OEDIPUS THE KING — Sophocles. English version by Dudley Fitts and Robert Fitzgerald. With George Dixon, Robert Clarke, Alwyn Owen, Lola Russel. Music composed and played by Lindsay Morehouse, Janic Clarke, Gillian Ashby. Proscenium Arch Recording, two 12-inch stereo discs, R-D 2001/2.

Interest: Greek drama.
Performance: Convincing.
Recording: Generally excellent.
Stereo Quality: Gimmicky.

The name Oedipus is a fairly familiar one to many people, having been virtu-

ally raised anew by Freud when he needed a convenient label for what he held to be a universal behaviour pattern in male child development — the "Oedipus Complex." But the original denotation of the name is perhaps less familiar.

In Greek mythology Oedipus was a prince who was made king of Thebes when he rid them of the scourge of a man-eating sphinx. It later became clear that the widowed queen he married was actually his own mother, and that he had killed his own father. He was blinded and exiled, later to be cared for by his daughters Antigone and Ismene.

The great Greek poet-dramatist Sophocles of Colonus (496-406), used the legend of Oedipus as the basis of two tragedies, while a third was based upon the story of his daughter Antigone. The present recording is from an English version of his play "Oedipus Tyrannus," which covers the events leading up to his blinding and exile and probes their effect upon Oedipus himself.

The performance presented on the recording is, it seems to me, close to the feeling of the original drama. George Dixon as Oedipus gives a most convincing and moving portrayal, and he is well supported by Robert Clark Creon, brother of the dead king Laios, Lola Russel (Iocaste, mother and wife of Oedipus) and Alwyn Owen (Teiresias, the prophet). The diction is excellent throughout.

Technically the recording is of a very high standard, although there are two criticisms which I would make. The first is that mixing balance or microphone placement leaves something to be desired in places, as characters sometimes sound

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quite distant and blurred by reverberation effects. Also at times the two characters involved in the action are virtually superimposed upon one another spatially — and this leads me to the second criticism.

This is that the stereo facility is employed in what I can only describe as a "gimmicky" fashion. Characters are as often as not huddled over to one side, virtually crawling over one another in the corner of the stage. Either this or they are shifted from one side of the stereo panorama — sometimes during a speech, and sometimes between speeches, which is even more confusing.

This sort of thing may be all right in a stereo demonstration record, but in a dramatic work it is downright annoying. Particularly so as the microphone balance was sufficiently out to cause a character to "fade out" in the middle of his translation from one side to the other. The effect was most distracting, as if the actor was being swung through a vast parabola on a length of elastic. Apart from these criticisms, however, the recording is of a high standard, as I said before — and if you can enjoy the play itself the technical shortcomings will soon fade into insignificance.

All told, then, a most interesting recording and one which should appeal to all students and lovers of Greek drama. Classics students and tutors may well find it of use both in its own right and as an example of an outstanding Greek tragedy. Those responsible for its production are to be congratulated. (J.R.).

★ ★ ★

MARY POPPINS. The "living Voices" with Orchestra. Arranged and conducted by Anita Kerr. Stereo, RCA Camden, CAS-881. (Also available in mono.)

Interest: Music from "Mary Poppins."

Performance: Excellent.

Quality: Excellent.

Stereo: Normal spread.

To quote the jacket notes: "The music from Walt Disney's 'Mary Poppins' is a sheer delight for the whole family."

And it certainly sounds that way, as recorded on this album from the RCA Nashville studios. To say any more would be to cloud the fact that is a simple, delightful presentation that you'll play over and over again.

The titles: "Step In Time," "Chim Chim Chere," "Medley," "Stay Awake," "Jolly Holiday," "The Life I Lead," "Feed The Birds," "Medley," "Let's Go Fly A Kite," "Super-Cali-Fragil-Istic-Expi-Ali-Do-cious" and "A Spoonful Of Sugar."

The sound quality is clean and, apart from a couple of isolated "crackle" spots the surface is excellent. One you shouldn't miss. (W.N.W.)

★ ★ ★

THE BAND WAGGON. Sound track recording, with Fred Astaire, Nanette Fabray, Jack Buchanan, India Adams. MGM Studio Orchestra and Chorus, conducted by Adolph Deutsch. Mono, MGM Encore Series MGM-V02-9112. Interest: Show music.

Performance: Sounds okay.

Quality: Routine.

I must confess that Band Waggon is a show that I know nothing about and the jacket, in keeping with the budget-priced Encore policy, has nothing whatever to say, by way of explanation. The

music struck me as being of the fairly routine show variety, heavily dependent on the visual, and therefore most likely to appeal to those who saw the film from which it comes.

The track titles: "A Shine On My Shoes," "By Myself," "Dancing In The Dark," "I Guess I'll Have To Change My Plan," "Louisiana Hayride," "I Love Louise," "That's Entertainment," and "The Girl Hunt Ballet."

The sound quality can be described only as routine, rather prominent in the middle register and not as clean as it might be in some spots. If you're keen on the music, don't let this remark stop you; It's just that it isn't up-to-the-minute hi-fi fare. (W.N.W.)

★ ★ ★

THE SOUND OF MUSIC—The Living Strings, arranged and conducted by Johnny Douglas. RCA Camden 12-inch stereo, CAS-869.

Interest: Broadway musical, film.

Performance: Smooth and bright.

Recording: Excellent.

Stereo Quality: Widespread.

For lovers of Rodgers' and Hammerstein's extremely popular musical "The Sound of Music," another version of the music. On this disc the Living Strings play most of the featured tunes, for those to whom the lyrics are less important. The arrangements by conductor Johnny Douglas are smooth, and the playing bright.

The tunes played are "Overture," "Maria," "My Favourite Things," "Do-Re-Mi," "Climb Ev'ry Mountain," "The Sound of Music," "Sixteen Going On Seventeen," "Something Good," "Edelweiss" and "I Have Confidence."

The recording is excellent, and the stereo widely spread, making the disc excellent value as an "economy label" recording. It can be warmly recommended. (J.R.)

★ ★ ★

CHU CHIN CHOW — Inia Te Wiata, Julie Bryan, Barbara Leigh, Charles Young, The Williams Singers, Michael Collins and his orchestra. H.M.V. "Encore" series 12-inch stereo, SOELP-9053.

Interest: Musical comedy.

Performance: Bright, warm.

Recording: High quality.

Stereo Quality: Smoothly spread.

I had the pleasure of reviewing the mono version of this recording some time ago, and my reaction has been the same on both occasions — I don't think one could want a brighter or warmer recording of the vocal highlights from "Chu Chin Chow." The principal parts are sung in fine style, with Inia Te Wiata outstanding as Chu Chin Chow, and the chorus gives firm and disciplined support.

The recording, while not perhaps quite up to the latest standards, is nevertheless of high quality.

Particularly in stereo, a fine recording and excellent value. Recommended! (J.R.).

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WALTZ TIME With The Living Strings, arranged and conducted by Johnny Douglas. Stereo, RCA Camden CAS-855. (Also available in mono.)

Interest: Popular waltzes.

Performance: Smooth, romantic.

Quality: Excellent.

Stereo: Normal.

The combination of waltzes and Johnny Douglas' Living Strings produces exactly the kind of sound that you'd expect—smooth, lush, romantic. It's easy on the ear and just the kind of sound to go with soft lights.

And among the titles are surefire favourites: "The Girl That I Marry," "Anniversary Waltz and Wunderbar," "Gold and Silver and The Skaters' Waltz," "Seven Golden Bells," "Love From A Heart Of Gold," "Dancing," "Dear Friend," "Roses From The South," "Be Still My Heart," "1001 Nights," "Where The Citrons Bloom" and "The Merry Widow."

Good value on the Camden label. (W.N.W.)

★ ★ ★

THE WORLD OF LIGHT MUSIC. The Pro Arte Orchestra, conducted by Gilbert Vinter. H.M.V. 12-inch mono, OCLP-1836. Also in mono on OCS-1588.

Interest: Light classics.

Performance: Brisk, warm.

Recording: Excellent.

The fifth in a series of light music recordings made by the Pro Arte Orch-

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estra, this disc features small pieces from many countries:

"The Merry-makers" Overture (Coates); "Herdmayden's Dance" (Alfven); "Praeludium" (Jarnfelt); "Entrance of the Little Fauns" (Pierne); "Under The Linden Tree" (Felix); "In A Harbour Town" (Fischer); "Dance of the Young Maidens" (Khachaturian); "Gitanarias" (Lecuna, arr. Gould); "Mardi Grass" (Grofe); "A la Clair Fontaine" (Farnon) and "March" (Arnold).

The guest conductor, Gilbert Vinter should be familiar to short-wave listeners from his many broadcasts conducting the B.B.C. Midland Light Orchestra. Under his baton, the Pro Arte gives a brisk and lively performance, with sufficient warmth and humour to prevent the string of works from becoming monotonous.

The recording quality is excellent, although the mono version sent for review naturally sound spacially confined.

For those who are lovers of the light classics, a disc well worth your attention. (J.R.)

★ ★ ★

LINGER AWHILE. Billy Vaughn and his Orchestra, Stereo, Universal Record Club, UP-686.

Interest: Swinging sax.

Performance: Bright.

Quality: Good.

Stereo: Marked separation.

"Linger Awhile" finds Billy Vaughn in a gay, swinging mood, with twin saxophones working overtime, just shading the percussion department. You'll enjoy it, whether you listen and tap your feet—or get up and dance to it.

"Whispering,"

"Red River Valley,"

"Do I Worry," "The Hucklebuck,"

"Under The Double Eagle," "You're The Only Star In My Blue Heaven,"

"When My Blue Moon Turns To Gold Again,"

"Beg Your Pardon," "Goodnight Sweetheart,"

"Side By Side," "You Are My Sunshine" and "Linger Awhile."

If you like swinging sax. Recommended. (W.N.W.)

★ ★ ★

COMMAND STEREO SAMPLER.

Originated and produced by Enoch Light, Command 12-inch stereo.

SNDL-2/2.

Interest: Stereo sampler, demonstration.

Performance: Sparkling.

Recording: Excellent.

Stereo Quality: Well spread.

A hi-fi stereo sampler and demonstration record from Enoch Light's label Command, featuring sample tracks from a dozen outstanding Command stereo albums. As many of the original albums were recorded on 35mm magnetic film masters the quality is quite excellent and the disc would be ideal as an equipment demonstration or "showoff" recording—the more attractive because of the low price of 39/6.

The tunes played are: "Anna" (from "Roman Guitar"), "April In Portugal" (from "Provocative Percussion"), "Banana Boat song" (from "Far Away Places"), "Heat Wave" (from "Stereo 35mm"), "On The Street Where You Live" (from "Provocative Percussion. Vol. 4"), "Caravan" (from "Bongos, Flutes, Guitars"), "I Could Have Danced



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All Night" (from "Pertinent Percussion Cha Chas"), "Tenderly" (from "Romantic Guitar"), "Love And Marriage" (from "Dimension 3"), "La Paloma" (from "Fiesta"), "A Hard Day's Night" (from "Great Themes From Hit Films"), and "If I Had A Hammer" (from "Discotheque").

An added feature is the listing of the Command popular stereo catalogue on the rear of the disc sleeve. (J.R.)

★ ★ ★
THE WORLD'S GREATEST MARCHES. The Boston Symphony and the Boston Pops Orchestras, stereo, RCA Dynagroove LSC-2757. (Also available in mono.)
Interest: Great marches.
Performance: Tops.
Quality: Very good.
Stereo: Good spread.

This is one of those records which offers the full symphonic orchestral sound with music which should suit those hi-fi enthusiasts who might be deterred by heavier fare. Frequency response, dynamic range, spread and definition are right up on modern standards.

And, having said this, I have probably said enough to tempt others to try and to buy.

Conducted by Erich Leinsdorf, the Boston Symphony Orchestra presents "Tanhauser—March," "Radoczy March," "Radetzky March" and "Stars And Stripes Forever."

On side 2, the Boston Pops under Arthur Fiedler presents "Procession Of The Nobles," "Pomp And Circumstance, No. 1," "Marche Slave," "French Military March," "Valdres March" and "National Emblem March."

Well played and well recorded, with not a trace of noise or distortion to spoil the sound. (W.N.W.)

★ ★ ★
THE ITALIAN TOUCH. Romantic Mediterranean Favourites by Ray Anthony and his Orchestra. Mono. Capitol T-2150.
Interest: Italian romanticism.
Performance: Capable.
Quality: Excellent.

Ray Anthony leads off with his trumpet and lots of sonic "bite" but this isn't to set the style of the music — only to provide the contrast. Much of the time, the sound stage is occupied by marimba, mandolin, accordion, reflecting rather more the Mediterranean mood.

However it adds up to a disc that most people should find very pleasant: "My Love, Forgive Me," "Carnival of Venice," "La Paloma," "Rimpianto," "O Maremarillo," "O Maria," "Sabor Ami," "Arrivederci Roma," "Villa Capri," "Amore Mio," "O Sole Mio," and Santa Lucia.

Technically, the sound quality is first rate. (W.N.W.)

★ ★ ★
BUT BEAUTIFUL. Andre Previn, piano, with instrumental accompaniment. Stereo, Universal Record Club SUP-495.
Interest: Rhythm piano.
Performance: Facile.
Quality: Normal.

Stereo: Not especially significant.
This particular disc has been in circulation for quite a while but I noticed it on offer recently among the Universal Club's dividend records—which means that it can be obtained quite cheaply.

Andre Previn has the typically nimble fingers of a pianist-entertainer and the ability to be gay, pensive or romantic

at will. He offers all three moods here, adding up to that kind of a disc which can be let play softly in the background while you read or relax.

"Flying Down To Rio," "You Are Too Beautiful," "When You Wish Upon A Star," "London In July," "Moonlight In Vermont," "Island In The West Indies," "How Are Things In Glocca Morra," "It Could Happen To You," "Honolulu," "My Foolish Heart," "But Beautiful" and "Sidewalks Of Cuba."

A bargain at the dividend price. (W.N.W.)

★ ★ ★
MOULIN ROUGE. The Melachrino Strings and Orchestra. Mono, RCA Standard Series 45EP. 20334.
Interest: French melodies.
Performance: Average.
Quality: Okay, but...

French melodies can be very pleasant, as also can the sound of the Melachrino Strings—but not when slight eccentricity causes a vague pitch waver as on side 1!

This doesn't help "The Song From The Moulin Rouge" or "J'Attendrai" but "La Seine" and "La Mer" are okay. (W.N.W.)

★ ★ ★
INVITATION. Peter Duchin, His Piano And Strings. Stereo, Festival SFL-931,364. (Also available in mono FL-31,364).

Interest: "Soft lights" music.
Performance: Good.
Quality: Good.
Stereo: Normal.

Peter Duchin could hardly fail to please with this new disc.

As a featured popular pianist, he has all the smoothness, the dexterity and the sense of rhythm that one expects of a polished performer.

For backing he uses romantic strings, relieved here and there with sax., clarinet and percussion, restrained and melodic but consistently bright.

The track titles: "Darn That Dream," "Let Me Love You," "The Good Life," "They Say It's Wonderful," "I Didn't Know What Time It Was," "Invitation," "That's All," "Angel Eyes," "Lazy Afternoon," "Maisonnette," "I Wish You Love" and "Sometimes I'm Happy."

A good one for Duchin fans but pleasant, in any case. (W.N.W.)

★ ★ ★
GEORGE WRIGHT PLAYS GEORGE GERSHWIN At The Wurlitzer Pipe Organ. Stereo, Dot (Festival) SZL-931,613. (Also available in mono ZL-31,613).

Interest: Wurlitzer pipe organ.
Performance: Virtuoso.
Quality: Clean and "hard."
Stereo: Pronounced.

For this recording, George Wright used his own 29-rank Wurlitzer pipe organ installed in a hard "Live" studio, with 4,000 square feet of floor space.

Not surprisingly, the sound is hard and clean, with sharp attack and fairly short decay.

Quite evidently, also, everything about the organ works — and reliably — while the layout and the microphone placement has been tailored for a high order of stereo separation.

All this makes demands upon the player, which George Wright is well able to meet. Surprisingly, however, he omits "Rhapsody in Blue" on the grounds that he feels unable to do justice to a number which "should have the originally intended full treatment, with

(Continued on Page 101)

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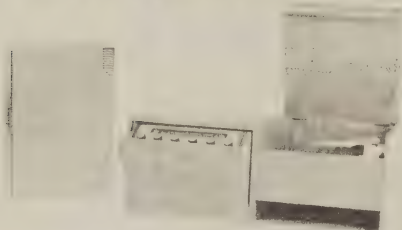
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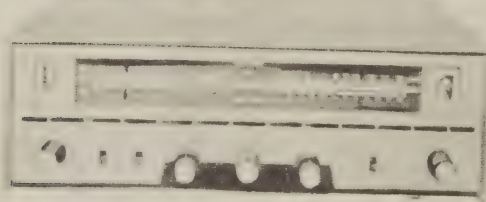
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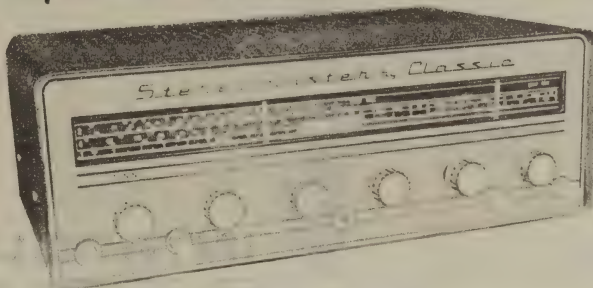
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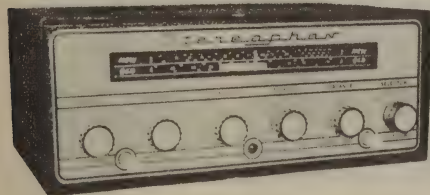
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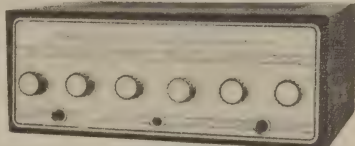
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VARIETY FARE - Cont.

symphony orchestra and concert pianist.

The numbers he does include are: "I Got Rhythm," "Embraceable You," "Swonderful," "Mine," "I'll Build A Stairway to Paradise," "Of Thee I Sing," "Wintergreen For President," "Swanee," "Bidin' My Time," "How Long Has This Been Going On," "But Not For Me" and "The Man I Love."

Well played, well recorded, and free from the tape hiss that often mars organ recordings, this is a good one for followers of the old-time cinema organ — albeit one with a "modern" sound. (W.N.W.)

★ ★ ★
JOHN ROBERTSON — Australian Trumpet Virtuoso, plays: "Spanish Gypsy Dance," "La Paloma," "Four Corners" (theme), "Petite Waltz." RCA, mono 45 EP. 20327.
Interest: Local virtuoso.
Performance: Fair hearing.
Quality: Only fair.

This is the second multi-trumpet recording made by John Robertson, lead trumpet with the Sydney Symphony Orchestra and acclaimed as one of the top ten trumpeters of the world. The first recording, "Malaguena" RCA EP.20316, was voted the "best Australian instrumental record of 1964" and became something of a "best seller" for RCA.

In this latest effort, John rises to even greater heights of versatility than he displayed on the previous recording. In the "Spanish Gypsy Dance" he plays no fewer than six trumpet parts, including the rarely heard and extremely difficult to play "piccolo" trumpet. This is probably the first time this instrument has been used in a pop recording and its piquant, impudent tones add to the exciting finish of this big-beat spectacular.

It would be nice to be able to report that the audio quality of this disc was as good as the fine musical content, but, unfortunately, this is not the case. The disc has a restricted frequency and limited dynamic range, both of these likely due to the technical limitations imposed by multiple recording techniques. The background noise level is also higher than today's usual standards. (K.W.J.)

PRE-RECORDED TAPE

PROVOCATIVE PERCUSSION—Volume 4, Enoch Light And The Light Brigade, 4-track stereo, 7ips, Command RS 4T 834.

Interest: Orchestral, percussion.
Performance: Impeccable.
Quality: Brilliant.
Stereo: Notable separation.

The Festival company, which distributes Command tapes in Australia, advise that this is one of a "Provocative Percussion" series, obtainable on 4-track pre-recorded tape or on stereo or mono LP discs.

The stereo disc "Provocative Percussion — Volume 4" was reviewed by Jamieson Rowe on Page 115 of our November, 1963 issue. His summary of the music I quote:

"It carries on the traditions of its predecessors with exuberant, fresh and highly listenable performances of 12 well-known tunes.

"There is plenty of zing, with transparent flutes and piccolo . . .

CONCERT CLASSICS, Kenneth McKellar with orchestra conducted by Robert Sharples. Pianist, Denis Woolford. Stereo, Decca SKLA 4663. (Also available in mono LKA 4663).

Interest: Vocal concert.
Performance: Excellent.
Quality: Good.
Stereo: Adequate.

Scottish artist Kenneth McKellar has built his very considerable popularity on the old-fashioned qualities of a good voice, and good musicianship. In this new recording he presents a generous group of his concert classics, some accompanied by orchestra under Robert Sharples, some by his regular and very capable pianist Denis Woolford.

Included are: "Caro Mio Ben," "Die Forelle," "Ich Liebe Dich," "Santa Lucia," "Serenade," "Sea Fever," "Torna A Surriento," "Nessun Dorma," "The Roadside Fire," "Dream Song," "Elegie," "Plaisir D'Amour" and "Matinata."

If you've an ear for traditional vocals, well sung and well presented, you'll certainly enjoy this disc. Technically, the sound quality is excellent, clean and well balanced, with no trace of surface noise. Recommended. (W.N.W.).

★ ★ ★
12 IMMORTAL SONGS—DICK CONTINO, accordion. Dot (Festival) 12-inch stereo, SZL-931,605. Also in mono on ZL-31,605.

Interest: Romantic accordion.
Performance: Smooth.
Recording: Very good.
Stereo Quality: Fine.

A smooth, very easy-to-listen-to recording of romantic favourites played by Dick Contino on the accordion and electronic "Chord-O-Vox." It would be very suitable for dancing at a party, for a quiet evening or for pleasant background music while one is working.

The tunes played are "Moon glow," "Tenderly," "Blue Tango," "Star Dust," "Ruby," "Yours," "Deep Purple," "Sentimental Journey," "Moon River," "Canadian Sunset," "To Each His Own" and "Begin The Beguine."

The recording quality is quite good, with low noise and distortion. The accordion and accompaniment are recorded on separate channels to accentuate separation and provide interest, but the effect is not exaggerated. (J.R.).

low register clarinet, taut but mellow guitar . . . muted trumpet, beefy trombone chorus and a tremendous assortment of wierd and wonderful percussion sounds . . . you name it, it's probably there!"

The titles: "On The Street Where You Live," "You're Getting To Be A Habit With Me," "That's My Desire," "Comme Ci, Comme Ca," "I Got It Bad And That Ain't Good," "Do-Do-Do," "Make Someone Happy," "You're An Old Smoothie," "Solitude," "With My Eyes Wide Open, I'm Dreaming," "The Look Of Love" and "I Love You."

As did the record, this tape doubtless came from a 35mm tape master, reflected in a very clean audio quality and excellent separation. However, unlike the record, the tape has acquired a background of "white noise," probably as a result of multiple dubbing and this will show up if your tape system is flat in the top register. (W.N.W.)

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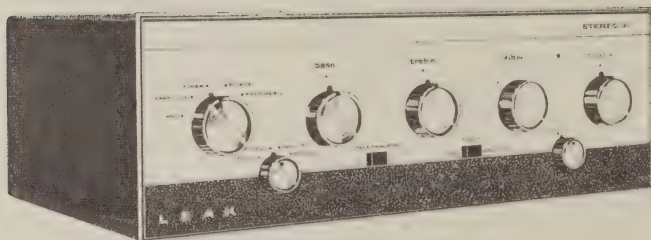
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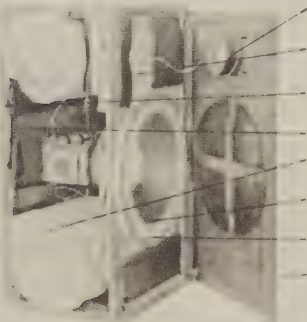


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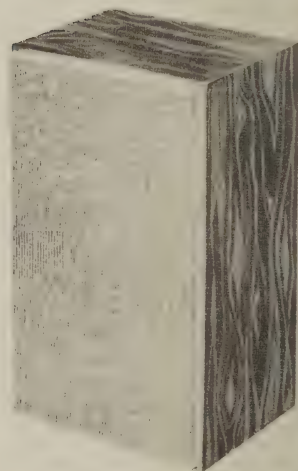
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THIS MONTH'S POPULAR JAZZ

THE JAZZ STORY, Volume 2, jazz of the twenties. Featuring the music of Phil Napoleon, Blue Lu Barker, Red Nichols, Jimmie Noon, Frankie Trumbauer, Julia Lee, The Capitol Jazzmen, Joshua Johnson, Ray Turner, Johnny Hodges, Earl Hines and Bobby Hackett, Capitol, Mono, T-2138.

Interest: Jazz historical.
Performance: First class.
Quality: Very good.

"The Jazz Story" is the title of a book described as "a definitive text on jazz" and written by Dave Dexter who is, incidentally, an executive producer at Capitol records. What could be more natural, then, that Dave Dexter should choose the tracks on five LPs which bear the name of his book.

The record under review is number two of the set and, if the choice of numbers and bands it contains is any indication, then the rest of the set would be well worth having.

This particular disc illustrates jazz of the twenties but, thank goodness, not with recordings made in the twenties. The majority of these tracks were cut in the years between 1943 and 1963 but the music is pure jazz of the twenties and with the distinct advantage of modern recording techniques.

An excellent example of this is the wonderful track of Red Nichols playing "Ida." Musically this is as fine a drop of Nichols as you are ever likely to hear, but recorded in 1956 and with an audio quality that can certainly be classified as "very good."

The rest of the tracks are equally satisfying, with the possible exception of "The Entertainers Rag" by Ray Turner. This track shows Turner to be rather large on digital dexterity and showmanship but I felt there were better examples of ragtime piano which could have been used. In all, however, I can heartily recommend this disc to those with an historical interest in jazz. The audio quality, as noted earlier, is generally good throughout the disc. (K.W.J.)

★ ★ ★
BECHET OF NEW ORLEANS. "I Though I Heard Buddy Bolden Say," "Maple Leaf Rag," "Weary Blues," "Egyptian Fantasy," "12th Street Rag," "Muskrat Ramble," "Shake It And Break It," "Texas Moaner," "Sweetie Dear," "Wild Man Blues," "Save It Pretty Mama," "When Its Sleepy Time Down South," "Ain't Gonna Give," "Baby Won't You Please Come Home," "Georgia Cabin," "The Sheik Of Araby." R.C.A. "Vintage Series," Mono. LPV-510.

Interest: Sidney Bechet.
Performance: Typically excellent.
Quality: Good forties standard.

Sidney Bechet was the New Orleans reedman who, almost singlehandedly, made the soprano saxophone a respected instrument in dixieland jazz. A self-taught musician, Bechet began playing clarinet back in the early 1900s but changed to the soprano sax when he found it softened the harshness his tremendous drive gave to his clarinet playing.

His feats on this instrument have delighted jazz enthusiasts for more than 30 years and, the supreme compliment, there is hardly a soprano sax player

alive today who is not influenced, in one way or another, by Bechet's playing.

Bechet was a fairly prolific recording artist and the tracks chosen for this LP are, I feel most representative of his art. He is mostly heard with his own group, the New Orleans Feetwarmers (a lovely title that); there is even one track with the Jelly Roll Morton group and a remarkable recording he made in 1941 in which he plays, by multiple recording process, soprano sax, clarinet, tenor sax, piano, bass and drums. It is most aptly titled "Sidney Bechet and his One Man Band."

Most of these tracks were cut in the early forties although some go back to 1932. The audio quality throughout is, I would say, of a good standard for the years involved and certainly nothing to worry the serious enthusiast. Highly recommended. (K.W.J.).

★ ★ ★
LOUIS ARMSTRONG—IN THE 30s—IN THE 40s. "Sweet Sue," "St. Louis Blues," "I've Got The World On A String," "Honey, Do," "Swing You Cats," "Mighty River," "Do You Know What It Means To Miss New Orleans," "Jack-Armstrong Blues," "I Wonder, I Wonder, I Wonder," "Before Long," "Where The Blues Were Born In New Orleans," "It Takes Time." R.C.A. Mono. LPM-2971.

Interest: Early Armstrong.

Performance: Restrained but interesting.

Quality: Pretty fair.

The thirties and forties was, of course, the era of the big bands so it is not surprising to find that, on 7 out of 12 tracks on this disc, Louis is featured with 11 and 17 piece "swing" orchestras. His performance with these groups generally lacks the "joie de vivre" of the earlier Hot 5 and Hot 7 recordings, this being a more restrained and polished Armstrong.

If his playing is restrained on these tracks, however, he more than makes up for it with some really fine and swinging vocals which, alone, are almost worth the price asked for the disc.

On the remaining 5 tracks he is featured with some of his more familiar sidemen — notably Jack Teagarden, Barney Bigard, Arvell Shaw, Kid Ory, Coby Cole and Bud Scott — in typical dixieland size groups and arrangements. These tracks were, incidentally, mostly recorded in the late forties when swing was being displaced by a dixieland revival of interest.

The audio quality of the disc varies somewhat but, in all, R.C.A. have done a fine job of reprocessing and I doubt whether any serious jazz enthusiast would be disappointed on this score. Historically the recording is interesting and well worth having, if only because of the scarcity, nowadays, of Armstrong recordings from this period in his career. (K.W.J.).

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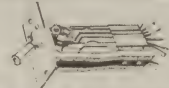
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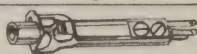
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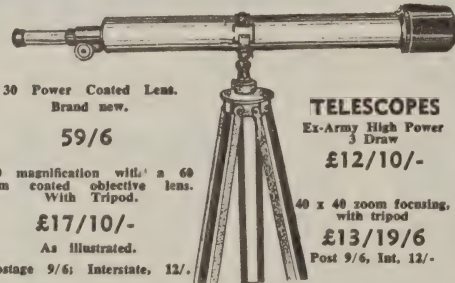
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wooden frame, Telescopic, Ex-
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No. 19 2-way radios, complete
with hand set, power supply,
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EVERSHED and VIGNOLES.
500 volts.

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PRISMATIC Coated Lenses.
Brand new. Complete with case.

8 x 30 ... £9 15 0
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10 x 30 ... £13 15 0
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SPECIAL ARMY RELEASE

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ALL LENSES
"ASTRONOMICAL" QUALITY
General and Marine
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4 x 40 Genuine HANDLEY.
Cost £30. Our Price £23/5/
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15 x 40 variable Power Otway,
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Achromatic Coated 2 Element
Air spaced. Unmounted.
Astronomical Quality

Make your own telescope or long-
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SCOTCH BRAND
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SLIGHTLY USED
PERFECT ORDER.

Can be used for home video, tape
recording equipment, etc.

2,400ft 12in Reel 1/2in Top Grade.
Cost £27/5/- Our Price £23/15/-
roll, Post 7/- Interstate 9/6/-

Also same in 1/4in. Ideal for pro-
fessional quality audio recording.
1200ft 7in reel 1/4in 27/6. Post 1/2
600ft 5in reel 1/4in 16/9. Post 1/2
200ft 3in reel 1/4in 6/6. Post 1/-

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U.S.A. 4-speed, 240 volt AC.
50 cys. Only 27/6 each.
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Encased, including switches, as
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Top grade, full enclosed trans-
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37 volt. 53 volt. 60 volt. £15.

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SPECIAL lucky dip valve offer.
12 new valves in cartons for
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Outpost 130 to 175 volts DC vari-
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Voltmeter, ammeter, D/P knife,
S/W for DC control 3 phase
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Ideal for charging electric
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TYPE 22 VIBRATOR

Power Supply less relay, output
200 volts at 125 milliamps with
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Sound Powered. Can be used as
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With 58c cable.

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TRADE REVIEWS AND RELEASES

AMPEX RECORDER, MODEL 2070

We recently had the opportunity to laboratory test the new Ampex Model 2070 recorder illustrated at right and found it to be an extremely well engineered machine, constructed to professional standards and performance, but with an appearance and overall operating ease which must make it an attractive proposition to the domestic market for which it is intended.

IN looking at this recorder the first thing one notices is the unique automatic threading mechanism which enables a tape to be placed on the machine in about the same time as it takes to place an L.P. record on a turntable. The heart of this mechanism is a special one-sided metal take-up spool which has a centre core consisting of a number of specially shaped "teeth." When the tape is pulled through the slot in the plastic covers over the take-up spool it passes through these teeth; when the start button is pressed the teeth grab the tape leader and wind it around the core in one smooth action.

A second major feature of the machine is its ability to play back tapes in both directions without the necessity for rewinding. The recorder is equipped with dual capstan drives, a reversible drive motor and dual playback heads; one for tracks 1 and 3 and the other for tracks 2 and 4.

The machine also comes complete with an automatic reversing mechanism and an automatic stop feature which switches everything off, both mechanically and electrically, at the completion of a tape. With these features the machine can play, automatically, both sides of a stereo or mono tape and then switch itself off at the end of the performance.

Although the machine will play back tapes in either direction, it can only be used for recording in the normal left to right direction because there is only one record/playback head and that arranged in the normal 1 and/or 3 combination. In order to record both sides of the tape it is necessary to replace the special automatic take-up spool with a normal spool—a very simple procedure. After recording on one side of the tape the spools may be reversed to record the other side in the normal manner.

Ampex are perhaps best known for the fine video, professional audio and instrumentation recorders they manufacture and the mechanical side of this domestic machine is, in actual fact, a scaled-down version of their Model 300 instrumentation recorder.

The drive system consists of a constant-speed hysteresis synchronous motor which has a three-stepped pulley for driving the capstans and another pulley for driving the reels. The capstan pulleys drive a belt which loops around two massive flywheels, one for each of the capstans.

In either direction of play, one capstan provides motion while the other creates a slight holdback tension. This combination, plus an ingenious automatic tensioner, eliminates the need for pressure pads and ensures precise tape tension and uniform tape travel across the heads, with almost ideal head-to-tape contact. The proof of this is in the wow and flutter figures which will be given later in our review.

The magnetic heads of the machine are mounted in a solid cast aluminium block and this, in turn, is securely bolted to the rugged diecast frame on which the remainder of the deck is assembled. The manufacturers claim that, even after a severe drop, the alignment of the system would not be affected.

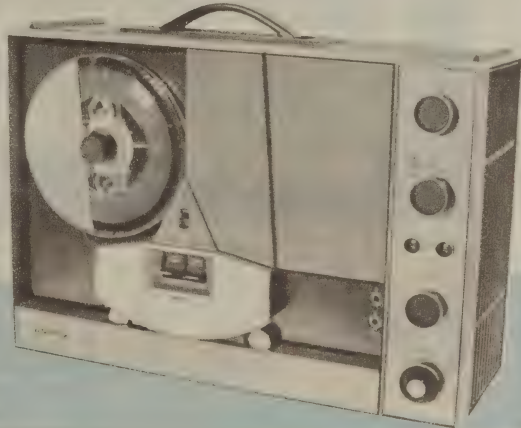
The Ampex 2070 weighs 39lb but this weight is directly related to strength and, as such, is a worthwhile investment.

The machine features a partly solid state, partly valve circuitry with all valves shock mounted to protect them against internal and external vibrations. The output circuit is solid state and transformerless and out-

1 7-8ips; signal to noise ratio—52dB at 7½ips; tone control range—zero to plus 12dB at 100cps and minus 4 to plus 10dB at 10KC; wow and flutter—0.08% at 7½ips, 0.12% at 3½ips and 0.2% at 1 7-8ips; speed accuracy—plus or minus 0.3% at 7½ips; fast wind time—115sec for 1,200ft of tape.

In addition to the features listed the machine has: Automatic tape lifter to prevent head wear; convenient cord storage compartment; automatic digital counter; interlocked controls to eliminate tape stress and breakage; attractive "snap-on" dust cover; fold down carrying handle; easily accessible mike inputs; "hidden" external and input and output receptacles; friction loaded gain controls for simultaneous adjustment of individual channels; a two-way muting switch for monitoring during record.

When tested in our laboratory the machine performed exceptionally well and easily



put power is 8 watts RMS per channel. External speakers would need to be used for best results but the unit does contain two wide-range speakers for monitoring or self-contained playback purposes.

The recorder is attractively finished in a silver and black metal case and panels and its appearance is such that it would not disappoint the most ardent professional while, at the same time, it would not look out of place in the average living-room set-up.

All controls are clearly labelled, conveniently grouped and easily accessible. The machine is engineered virtually to eliminate the possibility of damage through operating errors and even the most inexperienced person could play and enjoy the recorder.

Brief specifications of the Ampex 2070 are as follows: Overall record/playback frequency response — plus or minus 2dB from 30cps to 18KC at 7½ips; plus or minus 3 dB from 40cps to 12KC at 3½ips; plus or minus 3dB from 40cps to 6KC at

met all of those specifications which we were able to accurately measure. This is a particularly nice recorder to "drive" and its performance leaves very little, if anything, to be desired.

The Australian price of the Ampex 2070 has yet to be determined but the machine sells in America for \$19 dollars, list. The model reviewed is the dearest of the "2000" series available from Ampex, other models being available without the automatic features and, if desired, without the case and power amplifiers.

Accessories available include the "1000" and "2000" series external speaker systems, high performance dynamic microphones. Ampex slide projector actuator, Ampex special "500" series recording tape (the machines are specially adjusted for this tape), the Ampex 805 tape splicer.

Further enquiries on the model 2070 or any of the range of Ampex domestic recorders should be directed to Ampex (Australia) Pty. Ltd. of 29 Ridge Street, North Sydney, N.S.W. (K.W.J.).

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South Australian Agents for:—

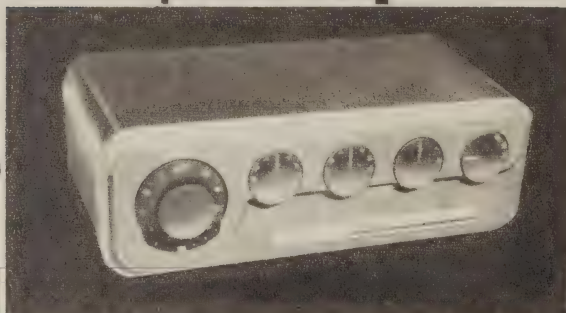
STANDARD COMPONENTS TUNERS

THE VERSATILITY OF THE

QUAD 22 CONTROL UNIT



AM Tuner. 56gns.



22 Control Unit. 64gns.



Used with a single QUAD 11 power amplifier the unit provides every facility and refinement necessary for highest quality monaural reproduction.

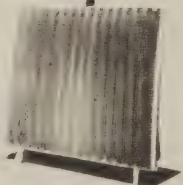
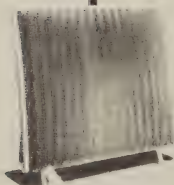


Amplifiers.
60gns. ea.



Used with two QUAD 11 power amplifiers, the unit will in addition accommodate all forms of Stereo programmes with all the necessary facilities for that medium. Whilst providing extreme flexibility—the push buttons, for example, provide nineteen different services—straightforward and logical control has been maintained.

Left: Electrostatic Loud
Speakers. 153gns. ea.



QUAD for the closest approach to
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Sole Australian Agent:

BRITISH MERCHANDISING PTY. LTD.
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WRITE FOR free descriptive literature and name of your nearest
QUAD Distributor, who will gladly demonstrate this equipment.

TRANSCEIVERS FROM TELCON

Strato Communications Pty. Ltd. announce the release of a new 27MC transceiver to be known as the "Telecon Model 214." The transceiver runs a full 1 watt of input on transmit and is a high-performance type most suitable for arduous conditions of operation.

THE new transceiver is housed in an attractive but rugged all-metal case which is finished in black crackle lacquer with silver anodised panels. Dual carrying handle rings are fitted to opposing corners of the case and the whole unit is shower-proof. The retracting whip aerial is the full legal length of 60in.

The receiver portion of the unit is a conventional superheterodyne design with an RF stage, wide range AGC, a very effective automatic noise limiter (switch operated) and an amplified squelch system which is very smooth in operation. The receiver sensitivity is 1 microvolt for 10DB S/N and maximum audio output is 250 milliwatts. A local DX (RF) gain switch is provided and the receiver is switchable over any two pre-selected channels in the 27.23 to 27.28MC range.

The transmitter runs, as previously mentioned, a full 1 watt of power input and Strato claim a minimum of 60 per cent efficiency from their final amplifier. Amplitude modulation of the transmitter is used and an in-built compression circuit holds the modulation very close to its maximum level of 95 per cent under average speech conditions. A jack is provided for use with an external microphone where required. The transmitter may also be switched to any two pre-selected channels in the range of the "citizens band."

In all the Telecon Model 214 transceiver uses 13 transistors and 2 diodes and is powered by normal "penlight" torch batteries. The unit weighs 1½lb (including batteries) and measures 9 x 3 x 1½ inches. It comes complete with a magnetic earphone and carrying case, a handstrap and plugs for the external battery and microphone jack. A nickel cadmium battery and charger are an optional accessory.

The unit is P.M.G. type approved and, in addition, has been approved by the Mines Department for use in explosive atmospheres. Transceivers of this model were used recently to provide communication in the Balls Head Pyramid climb when contact was actually established at a distance of 62 miles over water.

In our checks of the units we found the ANL and squelch circuits to be most effective in city operating since they would, in most circumstances, easily silence the background "hash" of automobile and electrical interference. In one test we maintained contact from inside two city buildings over a distance of some two miles.

Any further inquiries on these and other communications equipment should be directed to Strato Communications Pty. Ltd., of 25 Wentworth Street, Parramatta, N.S.W. (K.W.J.)

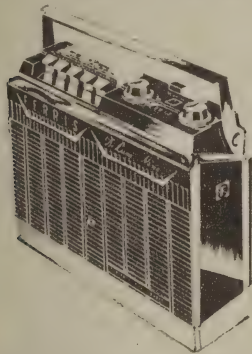


TRADE NEWS ... in brief

R. H. CUNNINGHAM PTY. LTD. advise that stocks are now available of Eddystone EC10 Transistorised Communications Receivers. This receiver has a coverage of 550KC to 30MC this range being covered in 5 bands without any break. Designed for AM and CW the receiver is also capable of receiving SSB. The manufacturers figures quote a sensitivity for 15dB signal-to-noise ratio as better than 5 microvolts on ranges 1 to 4 and better than 15 microvolts on range 5 (550-1500KC).

The intermediate frequency of the receiver is 465KC. The selectivity is fixed to give a bandwidth of 5KC at the 6dB points and 25KC at the 40dB points. Power is derived from dry cells housed within the receiver, with provision for dial lighting via a spring return switch. Enquiries may be addressed to branches of R. H. Cunningham in Melbourne, Sydney, Brisbane or Perth.

FERRIS PROS. PTY. LTD. announce the release of a new model Ferris Portable Car Radio Receiver, with push button tuning. This is claimed to be the first Portable Car Radio incorporating push button tuning, to be manufactured in the world. The



unit weighs 7lb including battery; it has a power output of 350mW as a portable or 2 watts as a cradle mounted car radio. The retail price for the Ferris model 224 is 45 guineas.

FERRIS INDUSTRIES LIMITED announce that the building of a branch office in Brisbane is expected to begin in July with completion to be in early September. Negotiations are in progress for the building of branch premises in Melbourne.

TECNICO ELECTRONICS PTY. LTD. announce the release of the Pye Smooth-speed Regulator. Utilising a silicon controlled rectifier this regulator is designed for use with Universal Series Wound motors 100 — 600W, 200 — 250 VAC, 50cps the continuous rating being quoted as 1½ amperes and intermittent rating 3 amperes. In use, the unit provides infinitely variable speed control from near-zero to approximately two-thirds of the usual maximum motor speed. Price of the model SS011 Regulator is £19/10/ plus tax.

W. J. McLELLAN AND CO. PTY. LTD. announce that they are now local selling agents for "BMB" sapphire and diamond gramophone pickup styli. A full range of styli are available, to suit most available pickup cartridges. (P.O. Box 69, Kingsgrove, N.S.W.).

BADISCHE ANILIN AND SODA-FABRIK AG. of Ludwigshafen, West Germany, have announced that the foundation stone for a new plant to produce their range of BASF magnetic recording tape has been laid. The plant will be built at Willstaett, West Germany at a cost in excess

of £A9 million and will provide the most modern facilities for the production of their magnetic recording tape.

The new plant, the largest of BASF's magnetic recording tape plants, will be the fifth operated by BASF itself or its subsidiaries. Australian agents for BASF are Henry York and Co. Pty. Limited, 46-47 Wilson Street, Botany, N.S.W.

CHANNEL MASTER PTY. LTD. announce the release of a new TV antenna, type 3110. A two-element inline phased array, it features a toroidal matching transformer and has high directivity over all channels 1-10. Retail price is £4/10/. (752 Pittwater Road, Brookvale, N.S.W.).

GENERAL ACCESSORIES announce that they have opened a new branch at 102 Northumberland Road, Liverpool, N.S.W., and also that they have moved into a new city showroom at 116 Clarence Street, Sydney. (Registered office at 443 Concord Road, Concord West, N.S.W.).

R. H. CUNNINGHAM announce the release of Nombrex transistorised test equipment in Australia. This range includes a Signal Generator covering 149KC to 166MC on fundamentals and up to 350MC on harmonics. Also included is a Wide-Range Audio Generator and a Wide-Range Capacitance Resistance Bridge. For details of these instruments and/or the Nombrex Transistor Power Supply Unit contact any one of the R. H. Cunningham branches at Melbourne, Sydney, Brisbane or Perth.

TECNICO ELECTRONICS PTY. LTD. are distributing a new range of magnetic field strength measuring equipment which uses a special type of semiconductor

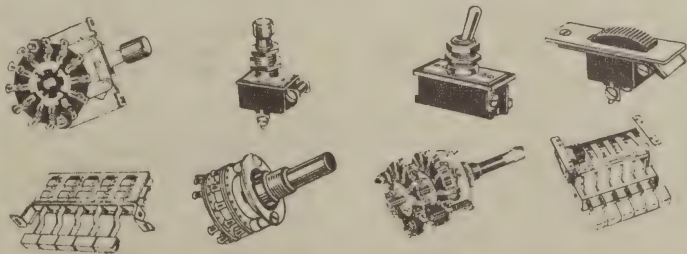
in the sensing probe. These instruments, manufactured by F. W. Bell Inc., utilise the Hall Effect phenomena as the measuring technique. Benefits are higher accuracy, wider range and small probe size. Main instrument in the range is an Incremental Gaussmeter with a resolution of one part in ten thousand.

RONALD J. T. PAYNE PTY. LTD. are offering a new range of laser equipment released by their principals G. and E. Bradley of the United Kingdom. The equipment described includes a Gas Laser type 602, Pulsed Ruby Laser type 351, Power Monitor types 151 and 152, Ruby Pulse Laser type 302 and DC Gas Laser types 611 and 612. Further information on this equipment may be obtained by application on company letterhead to Ronald J. T. Payne Pty. Ltd., 385-387 Bridge Road, Richmond, Victoria, or 12 Whiting Street, Artarmon, N.S.W.

MARCONI COMPANY LIMITED, exporters of Eddystone Receivers and equipment, advise that the manufacturers, Stratton and Company Ltd., have been officially renamed Eddystone Radio Limited. This follows the announcement last March that the Stratton radio interests had been acquired from Laughton and Sons Ltd., by English Electric, and that the company would be operated as a subsidiary of The Marconi Company.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD. have available a line of 40-ampere silicon power rectifiers, 1N1183A-1N1190A, with PIV's ranging from 50V to 600V. Peak surge amps are 800, with operation up to 200 degrees C. Reverse polarity types are available. A.W.V. also have available a complete line of English Electric industrial thyratrons. For further details on both silicon diodes and thyratrons contact the sales department, 47 York Street, Sydney.

Every Switch-user wants ABSOLUTE RELIABILITY



RELIABILITY has been carefully built-in to this wide-range of **OAK, CUTLER-HAMMER, NSF** and other world-renowned designs

More than 1,000 types available. Write for details of Rotary, push-button, piano-key, lever types, tool handle, push-push, slide, rocker, automotive, industrial and service approved types to:—



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PERTH. 21 9331; ATKINS (W.A.) LTD. PERTH. 21 0101.

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WELL-KNOWN MAKES BRAND NEW IN CARTRONS

(Postage 1/- per reel extra)		
150ft on 3in reel (Acetate Base)	6/	
225ft on 3in reel (Acetate Base)	7/6	
300ft on 3in reel (Tensilised Mylar)	12/	
500ft on 3in reel (Tensilised Mylar)	16/	
600ft on 3 1/4in reel (Tensilised Mylar)	17/6	
900ft on 5in reel (Acetate Base)	19/6	
900ft on 5in reel (Mylar Base)	22/6	
200ft on 5in reel (Mylar Base)	35/	
1800ft on 5in reel (Tensilised Mylar)	52/6	
1200ft on 3 1/4in reel (Mylar Base)	35/	
1800ft on 3 1/4in reel (Mylar Base)	52/6	
1200ft on 7 inch reel (Acetate Base)	25/	
1200ft on 7 inch reel (Mylar Base)	30/	
1800ft on 7 inch reel (Acetate Base)	35/	
1800ft on 7 inch reel (Mylar Base)	42/6	
2400ft on 7 inch reel (Mylar Base)	75/	
3000 on 7in reel (Tensilised Mylar)	75/	
3600ft on 7in reel (Tensilised Mylar)	92/6	

EMPTY TAPE REELS

3in	2/6	5in	3/6
3 1/4in	3/3	5 1/2in	5/6
4in	3/6	7in	5/

OR in Plastic Storage Box

5in	8/	7in	12/
COUNTO TAPE SPLICERS Complete with Splicing Tape and Instructions	3/		
BIB TAPE SPLICERS	27/6		

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PK-522 3 Transistor, Single Ended 50 mW Out-put	£2/17/6
PK-543 4 Transistor, Push Pull, 100 mW Out-put	£2/15/6
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PK-633 3 Transistor, 1 Diode, Broadcast AM Tuner	£2/15/6
"MITYAMP" 2 Watt Audio Amplifier, encased in Epoxysresin	£7/10/

LEADER Model LDM-810 GRID DIP METER

Specifications: 2 to 250 Megacycles with 6 plug in coils. Frequency Range: A — 2-5 Mc. D — 22-50 Mc. B — 4.6-11 Mc. E — 47-116 Mc. C — 10.5-25 Mc. F — 110-250 Mc.
Internal Modulation: 1 Kc. Approx.
Tube Complement: 6CW4 (Nuvistor).
Power Supply: 200/230 Volt 50 cycle.
Size and Weight: 6 3/4 x 2 3/4 x 2 inches 1.76 lb.
Price £22/5/- inc. tax

COAXIAL CABLES

UR67 50 ohm 3/4in diam. coaxial cable 1/6 yd. or 25/ per 27yds roll.	
UR43 50 ohm 3/16in diam. coaxial cable 15/ per 35ft roll.	
UR71 72 ohm 1/4in diam. coaxial cable 1/6 yd. or £1 per 25yds roll.	

ALL ABOVE CABLES ARE IN AS NEW CONDITION.

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Imported Germanium Pocket Radios Complete with Earphone and Instructions. £9/6 To Clear

SWR METERS Model KSW-10 SPECIFICATIONS:

Standing Wave Ratio: 1:1 to 1:10.
Accuracies: plus or minus 3% scale length.
Impedance: 52 ohms and 75 ohms.
Meter: 0-100 DC microamperes.

PRICE: £9/10/- inc. Tax

STEREO AMPLIFIER

10 wats (5 wats per Channel) £19/17/6 For details see March advert. RTV & H.

VACUUM TUBE VOLTMETER

"KEW" Model K-116 (PV202) Complete with DC Probe and Leads. £27/5/- inc. Tax. RF and HV Probes Extra.

CLEARANCE SALE

This Month Only

Mid-Year Sale of Disposal Equipment at our Store, 8 Pat. Street, GLENFERRIE, Phone 81-1935. Communication Receivers, Transmitters, Walkie-Talkies, Valves, Transformers, TR1935 Transceivers, Racks, Power Supplies, Resistors and Condensers and Surplus Electronic Equipment. STOCK MUST BE CLEARED. No Reasonable Offer Refused.

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AMERICAN TYPE

PL259 Coaxial Plug	9/6
4087-1 Coaxial Plug (PL259) (PTFE)	14/6
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C32-14 Coaxial Dbble. ended female Cable Joinder (PTFE)	17/6
UG175U Adaptor for PL259 to suit 1/4in Cable.	2/9
C32-17 Coaxial "T" Piece suit PL1259	23/3
BNC Series	
UG 88 C-U Coaxial Plug (PTFE)	15/9
UG290-U Coaxial Socket (PTFE)	12/6
Belling Lee Type	
Coaxial Plug (Suit 1/4in Cable)	4/
Coaxial Socket	3/6
Coaxial Socket (flush Mount)	3/6
Coaxial Cable Joinder (female)	4/

TRANSISTOR INTERCOM

4 Station, 1 Master, 3 Sub-Stations, 3 Transistor, 200 mW Output, Complete with 60yds wire, Battery, Staples, etc.	£10/5/
2 Station, 1 Master, 1 Sub-Station inc. Battery, Wire, etc.	£6/10/

ELECTROLYTIC CAPACITORS

Brand new, Sub-miniature & Pigtail, PVC sleeved

Mfd.	Volts	Price	Mfd.	Volts	Price
2	12	3/	50	25	4/3
2	3	3/6	50	52	14/6
5	12	3/	64	6	3/3
5	18	3/6	64	18	3/3
8	10	3/6	100	3	3/3
8	15	3/6	100	6	3/6
8	350	4/9	100	12	3/6
8	600	5/6	100	25	4/3
10	2	3/	100	200	10/
10	12	3/	(can PVC)		
10	12	3/	150	200	10/
10	25	3/3	150	150	7/6
16	10	3/3	100	100	7/6
16	300	5/3	200	25	6/
16	600	6/6	250	6	5/
20	200	5/6	250	12	5/3
24	350	6/6	250	25	6/3
24	600	10/	250	50	8/9
25	3	3/3	200	50	8/9
25	6	3/3	500	12	5/
25	25	3/6	500	50	13/6
25	50	4/3	1000	6	5/
30	6	3/	1000	12	9/9
30	12	3/	1000	18	10/6
32	350	5/	1000	25	13/6
50	6	3/	2000	18	17/
50	12	3/3	50 + 50 350	16/	

UNICORN 4 TRANSISTOR PORTABLE TAPE RECORDER UN-406 (2 track)

Specifications: 4 transistors, 1 thermister, 124 mW Circuit: 4 transistors, 1 thermister, 124 mW Output power.
Speed: 3 1/2, 1 p.s. Adjustable speed control.
Motor: 2 Micro motors.
Recording Time: 20 min. (200ft tape).
Microphone: Crystal with remote control switch. Complete with 200ft tape, 3in empty reel, microphone, earphone, and batteries, usual price £17/10/.

Our price £9/15/- inc. tax

SPEAKER TRANSFORMERS

Well-known make "B" Type.	
5000 ohm to 3.5 ohm	18/6
3000 ohm to 15 ohm	18/6
7000 ohm to 3.5 ohm	18/6
7000 ohm to 15 ohm	18/6
"C" Type.	
7000 ohm to 3.5 CT	25/
10,000 ohm to 3.5 CT	25/

POWER TRANSFORMERS

290v-0.290 volt 60Ma, 6.3v 2A, 5v 2A, 27/6	
300v-18 to 15 ohm 100Ma, 6.3v 3A, 5v 2A, 35/	
385v-0.185 volt 125Ma, 6.3v 3A, 6.3v 2A, 45/	
5V 2A	45/

SPEAKERS

Brand New, Bankrupt Stock, Well-known Make.	
Rin Twin Cone, 10 watt 15 ohm V.C., £3/19/6	
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WANTED TO BUY

COMMUNICATION RECEIVERS, TRANSMITTERS, TEST EQUIPMENT, AMPLIFIERS, TRANSISTOR RADIOS, TAPE RECORDERS, SPEAKERS, TRANSFORMERS, ETC.

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CENTRAL 200H Multimeter 20,000 opv D.C.	£5/12/6
CENTRAL CT500 Multimeter 20,000 opv D.C.	£26/15/
CENTRAL CT330 Multimeter 20,000 opv D.C.	£8
SAKURA TR6S Multimeter 20,000 opv D.C.	£8/10/
SANSEI SE550 Multimeters 100,000 opv D.C.	£12
Multimeter Probes	57/6
200H Movement	57/6
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MTC71/OC71 Transistors, 7/6 ea. or 3 for £1	
Subminiature Bezels 6-8 volt No. 3280 complete with globe. Red or black.	4/
GLORIA Extension Speakers (Plastic) Contains 4in Speaker and 12ft wire	50/
RESIN CORE SOLDER, 16 gauge	18/
40 60 1 lb packet	22/
SCOPE Soldering Irons 6 second Standard, 45/	
SCOPE Soldering Irons Deluxe Stainless Steel	50/
Barrell	
MINISCOPE Soldering Iron	45/
BIKKO Soldering Iron 6 second	39/6
TRANSFORMER Suitable Scope or Bikko	50/
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OAG1 Diodes	3/6
OAG210 power diodes	25/
High impedance Headphone	25/
Crystal Ear piece for Transistor Radio	6/6
Crystal Lapel Microphone	12/6
BM3 Pencil Type Crystal Microphone	50/

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WESTON Model LM3 12-volt Two-way Taxi Radios, Frequency 71 Mc. Approx. Easily converted for amateur use. Clean condition. Complete with Valves, Vibrator, Microphone and Cradle.

Price: £17/10/-
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9 Transistor 100 mW output Citizens Band, 27.240 Mc. Fully Transistorised Walkie Talkies, Individual Speaker and Microphone. Dimensions, 7 1/4in x 2 1/4in x 2in. Complete with Batteries, Earphone and Leather carrying case.

£42/10/- Pair

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New shipment of popular "P" Series Panel Meters	
P22 2in square clear plastic face. 1/4in round mounting hole, 3/4in deep.	42/6
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P25, 2 1/4in square clear plastic face, 2in round mounting hole, 3/4in deep.	42/6
P25-50 uA.	£4/2/6
P25-100 uA.	£3/12/6
P25-500 uA.	55/
P25-1 Ma.	47/6
P25-5 Ma.	47/6
P25-10 Ma.	47/6
P25-20 Ma.	47/6
P25-50 Ma.	47/6
P25-100 Ma.	47/6
P25-5 meter	58/
P25-VU meter	£3/15/
P25-15 volt DC.	47/6
P25-300 volt AC.	47/6
MR2P 5 volt	47/6
MR2P-15 volt DC.	37/6
MR2P-300 volt	47/6
MR2P-30-0.3 Amp	47/6
DC.	42/6

FOR DETAILS OF OTHER RANGES OF PANEL METERS SEE OUR ADVT. JUNE ELECTRONICS AUSTRALIA.

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CLIENTS PLEASE NOTE

ALL PRICES QUOTED IN THIS ADVERTISEMENT INCLUDE SALES TAX, WHERE APPLICABLE. PLEASE ADD POSTAGE WHEN ORDERING. SORRY, NO C.O.D.

AMATEUR BAND NEWS AND NOTES

Some concern has been expressed by all Divisional Councils of the Wireless Institute of Australia at the number of members who omit to remit their subscriptions for membership when they fall due in the first quarter of the year.

By Pierce Healy, VK2APQ*

ALTHOUGH a large percentage eventually rectify their oversight, nevertheless the work load imposed on the officers who carry out the management of Institute affairs in their spare time on an honorary basis is considerable and often unnecessary.

As the W.I.A. is the only recognised amateur radio body in Australia, full and uninterrupted support by all amateurs to their respective divisions is the only sure means of ensuring the continued expansion of the organisation and the services available to members.

NEW SOUTH WALES DIVISION

The June monthly meeting of the N.S.W. Division took the form of an Auction Sale. Business was kept to a minimum to allow members to participate in what proved to be the most popular type of meeting.

Quite a large amount of members' gear was submitted for sale and Noel Millar VK2AOH as auctioneer did an excellent job of enticing some spirited bidding from the ninety members present. From the satisfied expressions on the faces of the buyers, as well as the sellers, there is no doubt that the evening was a success.

A.O.C.P. CLASS

Vacancies exist in the current series of A.O.C.P. Classes run by the New South Wales Division at Wireless Institute Centre, 14 Atchison Street, Crow's Nest.

Intending amateurs who had not previously completed the course or who wish to brush up prior to the January 1966 examination should contact the Course Supervisor at the above address.

A correspondence course is also available for the Amateur Operator's Limited Certificate of Proficiency examinations.

W.I.C.E.N.

The reorganisation of the Wireless Institute Civil Emergency Network in New South Wales has been undertaken by Vic Cole VK2VL. Several proposals are being considered with the view of forming VHF and HF mobile nets to tie in with the State-wide net already in existence, based on the areas set out by the Civil Defence Organisation of N.S.W.

U.H.F. RECORD

A claim is being made for the longest distance yet worked in New South Wales on 432MC.

The contact was made over a distance of 177 miles between Phil Lockley VK2ZPT from his home location at West Pennant Hills about 12 miles to the north west of Sydney to Eddie Penikis VK1VP operating portable at Mount Ginini (5,790ft) near Canberra.

The equipment used by VK2ZPT was a crystal-controlled transmitter with an input of 85 watts to a QEO6/40. The antenna, a 13-element Yagi 31 feet high. The receiver a EC88 grounded-grid amplifier into a crystal-locked converter.

*News and notes of Divisional and Club activities, submitted for inclusion in these columns, should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.

The only details available of VK1VP equipment was that the transmitter had an output of 15 watts fed into a 13 over 13 element Yagi antenna. The receiver a crystal locked converter.

Signal reports:— VK2ZPT, using FM, was received at Readability 5 Strength 4, while VK1VP was received Readability 4 Strength 2. Both signals suffered from some QSB (fading).

The contact was made on June 14th at 1430 hours E.S.T.

HUNTER BRANCH

The June meeting of the Hunter Branch was well attended, there being 45 members and visitors present to hear Keith Jeffcoat VK2BK speak about improvements to the communications receiver recently described in "Electronics Australia" and a single sideband receiver for amateur use.

Keith gave very convincing demonstrations of this equipment and was able to create a good deal of interest from among the large audience. So many were the questions, that the "after lecture" session lasted until midnight.

A vote of thanks was moved by the president, Frank Cox VK2APO and carried by acclamation.

The next meeting of the Hunter Branch will be held in Room 6, Clegg Building, Newcastle Technical College, Tighes Hill on Friday, August 6, commencing at 8 p.m.

The lecturer will be David Pyke, of Union Carbide, who will speak on dry cells in general use and the use and charging of nickel cadmium accumulators in particular. Mr Pyke intends to give an extensive report on current products of use to the radio amateur.

This lecture is a must for those who wish to make best use of portable power supplies.

Visitors are always welcome at Hunter Branch meetings and all interested are invited to come along on Friday next.

The Hunter Branch Convention will be held this year on the 1st, 2nd and 3rd October. Full details will be given in the September issue of these notes.

The September meeting will be held on Friday, September 3. Full details of the lecture for this meeting will be given in the Hunter Branch news broadcast which may be heard weekly at 7 p.m., Mondays, from VK2AWX on frequencies of 1815KC; 3595KC and 7050KC.

CENTRAL COAST SECTION

The June meeting of the Central Coast Section held at the School of Arts Gosford was well attended, there being 38 present. These included two visitors from Newcastle and two new members, L. Brett and J. Daller.

The program for the evening dealt with Space Travel. Two films were shown, both in colour. The first was on the United States Mariner II satellite; this was followed by a film on Friendship 7, in which John Glenn orbited the earth.

All present agreed that it was a most interesting evening.

Meetings are held on the third Friday of each month in the School of Arts Gosford at 8 p.m. Visitors are welcome. Study

classes for the A.O.C.P. examinations as well as practical construction groups are part of the Section's activities.

ORANGE DISTRICT CLUB

The annual meeting of the Orange District Radio Society was held on Friday evening May 28th at the Club Rooms in Peisley Street, Orange. Eight members were present.

In presenting his annual report the club president Frank Aplin expressed his satisfaction on the activities of the club during the past twelve months.

Four members of the club obtained their A.O.L.C.P. during the year, they were Frank Aplin VK2ZFE, Jim Heron VK2ZHJ, Robert Alford VK2ZJR and Kees Nieuwendyk VK2ZKN.

The Friday night meetings had been well attended during the year. Activity of the club station VK2AOA on the 40 and 80 meter bands had increased during the year and the attendance on Sunday mornings for the W.I.A. broadcasts and call backs was only missed three times.

All offices being declared vacant, the retiring secretary presided over the election of officers for the ensuing year.

Nominations were called for and the following were elected:— President, Frank Aplin, VK2ZFE; vice-presidents, Don Kirby VK2ALX, Lindsay Moffatt, VK2-ZKL; Secretary-treasurer, Kees Nieuwendyk, VK2ZKN; councillors, Brian Warren, VK2ZQX, Peter Nieuwendyk, Associate.

The evening concluded with members resolving to construct six meter equipment for the club station and to concentrate on Morse code classes in order to obtain more fully licenced members.

An invitation is extended to those interested in amateur radio and living in Orange or surrounding districts to visit the club. Full details can be obtained from the secretary.

VICTORIA VHF GROUP

Over fifty members attended the June monthly meeting held at the rooms of the division located at 478 Victoria Parade, East Melbourne.

The evening was devoted to a buy and sell night when a large amount of equipment changed hands.

It was also reported that VK3AHL had received signals from Oscar III on 145.85MC during daylight hours of mid-June. However, as no night passes have been heard, it has been assumed the transmitter is being powered direct from the Solar batteries, thus accounting for the signals in daylight hours.

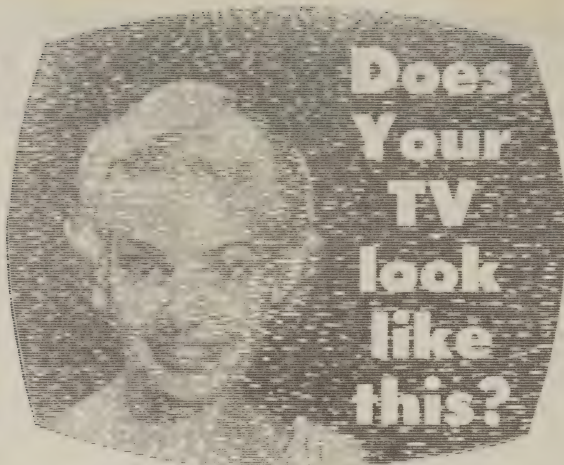
The annual convention of the Victorian Division V.H.F. Group has been tentatively scheduled for October. Details of the arrangements will be given over divisional broadcasts and in these notes.

SOUTH AUSTRALIA

The council of the South Australian division have circulated a "Questionnaire" to all members for them to express their views on several projects which the council is considering. These are:—

1. Holding a State Convention—annually or biennially.
2. Additional test equipment for loan to members.
3. A reference library for use by members.
4. An intra-State contest between city and country stations with worthwhile trophies.

Co-operation by members will assist council to plan for the future advancement of the division.



Don't blame your set

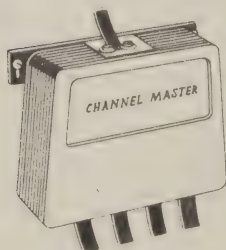
... it may be time to study



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752 Pittwater Road, Brookvale. XF 0221.

Send me your "TV Trouble Spotter" Folder.

NAME

ADDRESS

On the weekend of June 12th — 13th, the South-East Zone at Mount Gambier, held their annual VHF convention which attracted over fifty Melbourne, Victorian country and South Australian VHF enthusiasts. Activity was intense and extended into the small hours of the morning.

Ten competitions were held and the results indicated that the Victorian visitors had things all their own way.

Some interstate 52MC mobile contracts were made by those travelling to and from the convention.

WEST AUSTRALIA

From the West Australian Divisional bulletin it is learned that Brian Pemberton VK6VW, has taken over the duties of W.I.C.E.N. officer for that state.

Members who wish to join this organisation should contact Brian.

The Youth Radio Scheme Co-ordinator, Laurie Jessop VK6ZEA, has issued an invitation to those interested in forming clubs to contact him for any details they may require.

TASMANIA

Full details of the office bearers of the Tasmanian Division are:—President, Tom Allen, VK7AL; vice-presidents, Terry Connor, VK7CT; Ian Nicholls, VK7ZZ; treasurer, Tiny Dore, VK7JD; secretary, Charlie Spiegel, VK7KS; bulletin editor, Ted Beard, VK7EB; minute secretary, Geoff D'Emden, VK7ZAS; Federal councillor, Ted Cruise, VK7EJ.

A cordial welcome will be extended to any amateurs who may be visiting the "Apple Isle" on holidays, particularly "mobileers."

VALE

It is with regret that the death is recorded of two well known New South Wales amateur operators.

Jesse Carter VK2QC, after a long illness passed away on June 14. For some time prior to the beginning of this year Jesse was the division's Librarian, and until then, was, when his health permitted, active on 40 and 80 meters during the day.

Jack Francis VK2OF, who had also experienced poor health for some time, passed away on June 27. Jack was well known to country amateurs, particularly in the Central West where he resided at Molong for many years.

To the families of both these amateurs deepest sympathy is extended.

28MC DX

A report from Tom O'Donnell VK2OD, who monitors the 28MC band for long distance propagation, indicates that the ten metre band is open quite often to Central and West Coast U.S.A., Alaska, and Pacific areas from approximately 0930 to 1230 EST, and many good contacts have been made.

SINGLE SIDEBAND

Many of the exponents of Single Sideband in Sydney and interstate were surprised to hear the call VK2APQ suddenly appear without any warning on 20 meters sideband during June.

Probably the most surprised was Ted VK2ACD, with Muriel VK2AIA, Sid VK2SG, Alec VK2FM and Keith VK2BK just a little less curious.

It is strange how one's interest in a particular band tends to have him associated completely with that band. In this case the call sign VK2APQ was generally associated with 144MC in particular and 40 and 80 meters, hence the surprise.

The reason for the excursion into the field of 20 meters SSB was to evaluate the performance of the "SBE model 33" transceiver. From reports and observations this almost completely transistorised transceiver performs exceptionally well. Using a 20-meter dipole antenna about 15 feet above ground, very comparable reports were received from the U.S.A. and Australian interstate stations.

This particular model covers 80, 40, 20 and 15 metre American phone bands. Un-

ELECTRONICS Australia, August, 1965

fortunately the 80 and 40 metre frequency ranges are outside the Australian frequency allocations.

The unit uses only three valves, these are the driver and power amplifier stages in the transmitter. There are 18 transistors and 18 diodes in the receiver, sideband generator, oscillators and mixer sections.

The output is rated at 70 watts average; the unit weighs 15 pounds and is 5½ inches high, 11½ inches wide and 10½ inches deep, complete with power supply.

The possibility of a model being produced to suit Australian conditions is being investigated. Should this eventuate, it should become a popular piece of commercially built sideband equipment.

1964 R.D. CONTEST — RESULTS

The 1964 Remembrance Day Contest results again emphasised the necessity for a higher percentage of logs to be submitted by amateurs in larger divisions if they are to stand a chance of winning. As it was, South Australia took the honours, and it is interesting to note that this state submitted 111 logs — a much higher figure than any other state — and also scored a much higher figure — 914 — for the top six logs average. This contributed greatly to the overall success of South Australia.

YOUTH RADIO SCHEME

Club Leaders are reminded that their members may participate in the Receiving Section of the Remembrance Day Contest. See Rules elsewhere in these notes.

Inter-club or intra-club competitions could afford quite a lot of entertainment for members over the weekend August 14th-15th.

WESTLAKES RADIO CLUB

A very successful Field Day was held at the Westlakes Radio Club on Sunday, June 13th.

Over 100 attended and competitions were held throughout the day. Since the activities of the Westlakes Radio Club is associated with the Youth Radio Scheme, most of the contests were designed for junior members.

Eight transmitter hunts were held, six being for pedestrian hunters while two were for those using mobile equipment in their cars.

The winners of the hunts were: Tony Mullen VK2ZCT, Jim Thompson VK2AHT, Henry Schroeder (Jnr.), Paul Linsley, Wal Lean (Jnr.), Bruce Morley, Ray Carpenter and Leon Skeers.

Other contests held during the day were: — Morse Code copying, won by Ivan Agar, VK2AIM; Mystery voices won

An award will be made to the contestant who submits the highest scoring log covering any consecutive 24 hours within the period of the contest. This section cannot be won by the winner of the trophy awarded for the full period of the contest. It is also possible that other changes will be incorporated in the rules.

1964-65 TROPHY WINNER

VK3ZER R. W. Wilkinson, 5,787

AWARD WINNERS

SECTION A — TRANSMITTING OPEN

VK2ASZ R. L. Lear, 2,240
VK3QV D. H. Rankin, 108
VK4PU J. D. Purdon, 1,822
VK5CL H. M. Blythe, 266
VK6LK C. J. Kosina, 1,634
VK8KK D. A. McArthur, 4,312

SECTION B — TRANSMITTING PHONE

VK1VP E. Penikis, 1,386
VK2ZFB A. F. Birch, 2,220
VK3ZER R. W. Wilkinson, 5,787
VK4ZLG G. M. Lloyd, 3,338
VK5ZKR C. M. Hutcheson, 4,245
VK6ZNC A. L. Martin, 2,434
VK7ZAH K. J. Hendricks, 1,626
VK8ZMD A. M. Dunn, 180
ZL1AMN D. A. Johnston, 330
ZL2APC H. Burton, 340
ZL3AAU J. C. Miller, 950

SECTION C — RECEIVING

WIA-L2211 R. C. Abernathy, 466
WIA-L3138 G. N. Earl, 78
WIA-L5049 D. De Caen, 1,404

NEW DX CONTEST

In order to stimulate DX activity throughout the world, the Long Island DX Association is sponsoring an annual DXCC Contest "All the DX you can work in a year."

The contest will commence at 0001 GMT January 1, 1965 and end at 0000 GMT December 31, 1965.

Contestants will be required to work as many different countries over 100 as possible, in order to be eligible for the special prize which will be offered by the LIDXA.

Any mode and any band may be used, but just one confirmation from each country will count.

The Contest will be based on the ARRL DXCC rules, and the ARRL countries list will be followed.

The prizes to the winners will be:—

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A Practical Stott Course

STOTT amateur radio students receive the individual guidance of a highly-qualified radio engineer, and the Course incorporates the latest advances in the application of electronics to the design, construction, and operation of modern radio receiving apparatus.

Mail the coupon for full particulars of the Stott Course in RADIO FOR AMATEURS.

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ADDRESS

..... AGE (E.A.8.65)

	Total State Score	Aver. Top Logs	Licensees	Log Entry	Per- cent- age	State Log Aver.	TOTAL STATE POINTS
VK2—New South Wales	12,686	628	1,293	89	6.9	142.5	1,501
VK3—Victoria	13,819	684	1,078	66	6.1	209.2	1,530
VK4—Queensland	11,673	671	397	87	21.9	134.1	3,229
VK5—South Australia	19,521	914	452	111	24.5	175.8	5,707
VK6—Western Australia	8,767	455	255	82	32.1	106.9	3,274
VK7—Tasmania	4,519	384	120	38	31.6	119.0	1,815

STATE TROPHY

South Australia 5,707

HIGHEST STATE LOG AVERAGE

Victoria, 209.2

HIGHEST INDIVIDUAL SCORE

VK5ZP J. McL. Vale, 1,270

AWARD WINNERS

OPEN

VK1RD R. Davis, 373
VK2BO E. L. Andrews, 607
VK3ALZ I. F. Berwick, 843
VK4RH A. L. Hoey, 920
VK5ZP J. McL. Vale, 1,270
VK6CL L. H. Clinch, 560
VK7DK D. H. Kelly, 376
VK9XI Christmas Island Radio Club, 131

PHONE

VK1QL R. L. Weatherley, 371
VK2AHM R. J. Whyte, 1,089
VK3MO L. J. Williams, 965
VK4DA M. J. Swaby, 678
VK5ZK G. H. Herden, 1,111
VK6LR L. G. Rock, 520
VK7KH K. A. Hancock, 402
VK8KK D. A. McArthur, 322
VK9AG A. G. Nunn, 35
VK0PK P. King, 516

C.W.

VK2QL F. T. Hine, 519
VK3AXK S. R. Coleston, 383
VK4JF J. Files, 230
VK5ZC A. J. Penney, 347
VK6WT D. Couch, 374
VK7SM S. G. Moore, 485
VK8LX L. W. Wallbridge, 14
VK9GC A. H. Sandilands, 116

RECEIVING

VK1 A. Davis, 651
VK2 D. W. Shepherd (L2033), 420
VK3 G. N. Earl, 832
VK4 W. Thorpe, 662
VK5 A. F. Raftery (L5065), 821
VK6 P. W. Drew (L6021), 1,115
VK7 G. C. Johnston, 908

by Les Baber VK2RJ; component recognition won by Chris Cowan VK2PZ. The mobile scramble resulted in a win for Col Jeffery VK2ACK.

Among the distinguished guests present were Chris Cowan VK2PZ and John Clark VK2DZ, the Chairman and Secretary of the Newcastle Division of the Institution of Radio and Electronic Engineers.

During the prize giving those gentlemen presented the I.R.E.E. Efficiency Pennant for 1964 to the Westlakes Radio Club. This award is made annually to the Youth Radio Scheme Club which makes the best progress.

The pennant was accepted on behalf of the Club by the president, Keith Howard VK2AKX.

The recently erected 160-metre folded dipole at the Westlakes Club is now in operation and preliminary reports indicate that the installation is a great success with loud signals now audible on this band within the Hunter Branch area.

Later it is proposed to increase the power input to 150 watts on this band.

There has been a good response to the course "Electrons in Motion" which was transmitted during June and July.

Since some listeners may have missed these broadcasts, they will be made again in the spring; details will be announced in the September issue of these notes.

ROSS HULL MEMORIAL V.H.F. CONTEST 1964-65 RESULTS

Some quite good scores were recorded in the 1964-65 Ross Hull Memorial Contest. This contest is held each year during the December-January period to commemorate the memory of a brilliant Australian amateur who lost his life while working in the United States of America.

It was agreed at the recent Federal Convention of the W.I.A. to introduce a new section in this year's contest.

CRYSTAL



DIVISION

Manufacturers of Quartz Crystals for frequency control and Crystal Filters for highly selective circuits in the largest and most modern crystal plant in the southern hemisphere announce a new range of:—

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1.8 Mc/s to 15 Mc/s $\pm 0.005\%$ in Style "D" (American HC6/U holders. $\frac{1}{2}$ in pin spacing. Amateur net £2/16/3 incl. tax.

15 Mc/s to 52 Mc/s $\pm 0.005\%$ in Style "D" (American HC6/U holders. $\frac{1}{2}$ in pin spacing. Amateur net £3/2/- incl. tax.

100 kc/s $\pm 0.005\%$ in HC13/U holders. $\frac{1}{2}$ in pin spacing.
1 Mc/s $\pm 0.005\%$ in Style "D" (American HC6/U) holders. $\frac{1}{2}$ in pin spacing. Specially designed for Xtal Calibrator purposes. Amateur net £4/10/- incl. tax.

455 kc/s (nominal) crystals for Filter applications in Style "D" or "E" (B7-G) holders. Amateur net £4/10/- incl. tax.

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The Long Island DX Association Trophy — To the top Scorer in the World.

Six unique trophies:—To be awarded to the top scorer in each of the six continents.

Individual Certificates — To be awarded to the top scorers in each country from which entries are submitted, as well as winners in each of the U.S.A., Canadian and Australian districts.

At the close of the contest, participants will be required to submit just their lists of confirmed countries worked to:— Long Island DX Association Contest, P.O. Box 599, Lynbrook, New York, with post marks not later than February 15, 1966.

Potential winners will be notified and will be requested to submit the QSL's to the contest committee. The members are:— Joe Hellman W2MES, Dot Strauber K2MGE, Win Tames WA2QNW and Mary Fricklas W2FGD.

Further information can be obtained from the address given above.

NEW UHF DOUBLE-TETRODE

A double-tetrode valve designed for use in mobile equipment and capable of efficient operation up to 500MC has been released in the Mullard series.

Known as YL-1190, it will give 33 watts output at 200MC and 20.5 watts at the higher frequency. It is of single-ended construction, to simplify in-line circuit design and is of the quick heating type, to minimise current consumption on stand-by.

It has a 1.1 volt, 3.8amp filament and gives 70 per cent of its output within half-a-second of switching on from cold. This quick heating characteristic makes it specially useful in hybrid circuits involving transistors in low power and modulating stages.



only the TELECON TMC214 TRANCEIVER has

650 M.W. output for 1 watt in—A noise limiter that does! Sensitivity step switch — Battery meter, external battery jack—Better than I U.V. sensitivity—Amplified squelch control — High definition audio, external mic. Jack—Optional rechargeable batteries—P.M.G. and Mines Dept. approved—Two channel operation, and 6 months' warranty—Service and spares in all States—In use with over 20 Government Departments— £120/15/ (\$241.50) per pair inc. 12½ p.c. Sales Tax.

(See Tech. Review this issue.)

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1965 REMEMBRANCE DAY CONTEST

THE rules of this annual contest which perpetuates the memory of those members of the Wireless Institute of Australia, who paid the supreme sacrifice in World War II, have been extended to enable the holders of a Limited Licence to participate.

Following discussions at the Wireless Institute of Australia Federal Conventions over the past three years, an additional section has been added to the rules of the 1965 Remembrance Day Contest. The change will allow the holders of a Limited Licence to participate on an intrastate basis.

Although this section will not be taken into account in assessing the final points score of each State, the results this year will be used as a guide which may enable further changes to be made. It is hoped that all VHF-UHF operators will take part in this year's contest. A perpetual trophy is awarded annually for competition between Divisions. It is inscribed with the names of those who made the supreme sacrifice in World War II and so perpetuates their memory throughout Amateur Radio in Australia. The name of the winning Division each year is also inscribed on the trophy and, in addition, the winning Division receives a suitably inscribed certificate.

OBJECTS:

Amateurs in each Call Area including Australian Mandated Territories and Australian Antarctica will endeavour to contact Amateurs in other Call Areas. In addition, Amateurs will endeavour to contact any other Amateurs on the authorised bands above 52MC (i.e. infra-red), and will be permitted on the VHF-UHF Bands).

CONTEST DATE:
Commencing at 0800 hours GMT (6 p.m. EST) Saturday 14th August, concluding 0759 hours GMT (5.59 p.m. EST), Sunday 15th August 1965.

All Amateur Stations are requested to observe 15 minutes silence before the commencement on the Saturday afternoon. An appropriate broadcast address will be relayed from all Divisional Stations during this period.

RULES:

1. There shall be five sections of the contest:—
(a) Transmitting Phone.
(b) Transmitting CW.
(c) Transmitting Open.
(d) Receiving Open.
(e) Transmitting Open — VHF-UHF only.

2. All Australian Amateurs may enter the Contest whether their stations are fixed, portable or mobile. Members and non-members of the W.I.A. will be eligible for awards.

3. All authorised Amateur Bands may be used but cross-band operation is not permitted.

4. Amateurs may operate on both phone and CW during the Contest, i.e. phone to phone or CW to CW. However only one entry may be submitted for sections (a) and (d) in rule 1. A Separate entry may be submitted for section (e) in rule 1.

5. An open log will be one in which points are claimed for both phone and CW transmissions. Refer Rule 11 concerning log entries.

6. Multi operators are permitted. However, a second contact can be made on the same band using the alternate mode. Arranged schedules for contacts on other bands are prohibited.

7. Multi operator stations are not permitted. Although log keepers are permitted, only the licensed operator is allowed to make contact under his own call sign.

8. Should two or more wish to operate any particular station, each will be considered a contestant and must submit a separate log under his own call sign. Such contestants shall be referred to as "substitute operators" for the purpose of these rules and their operators proceed as must be as follows:—Phone: Substitute operators will call "CQ RD" or "CQ Remembrance Day" followed by the call sign of the station they are operating, then the word log followed by their own call, e.g., "CQ Remembrance Day CQ VK4888 log VK48AA."

CW: Substitute operators will call "CQ RD" followed by the group call sign comprising the call of the station they are operating, a radio telephony standardised test tone, e.g., "CQ RD de VK4888/VK48AA." Contestants receiving signals from a substitute operator will qualify for points by recording the call sign of the substitute operator only.

9. Entrants must operate within the terms of the licence.

10. CIPHERS—Before points may be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial numbers of five or six figures will be made up of the RS (teletype) or RST (CW) reports plus three figures, that will be used by one of each successive contact. If any contestant reaches 999, he will start again with 001.

11. Entries must be set out as shown in the

example, using ONLY ONE SIDE of the paper; wherever possible, standard W.I.A. Log Sheets should be used. Entries must be clearly marked "Remembrance Day Contest 1965" and must be postmarked not later than 6th September, 1965. Address all entries to:—FEDERAL CONTEST MANAGER, W.I.A., Box 1002, G.P.O., Perth, Western Australia.

12. Scoring will be based on the table shown below. A bonus of 25 points may be claimed for the first contact with other call areas on each of the bands 52MC and above.

In addition, all intrastate contacts on bands 52MC and above are worth one point each.

13. All logs shall be set out as in the example showing the following information:—
NAME
ADDRESS
SECTION
CALL SIGN

Declaration: I hereby certify that I have operated in accordance with the rules and the spirit of the contest.

SIGNED DATE

All contacts made during the contest must be shown in the log submitted (see rule 4). If an

The trophy shall be forwarded to the winning division in its container and will be held by that Division for the specified period.

RECEIVING SECTION: Section (d) Additional Notes:

1. This section is open to all Short Wave Listeners in Australia, but no active transmitting station may enter.

2. Contest times and loggings of stations on each band are as for transmitting.

3. All logs shall be set out as shown in the example. The scoring table to be used is the same as that used for transmitting entrants and the points must be claimed on the basis of the State in which the receiving station is located. A sample is given to clarify the position. It is not sufficient to log a station calling "CQ"; the number he passes in a contact must be logged.

4. It is not permissible to log a station in the same call area as the receiving station on the MF and HF bands, i.e., 1.8MC to 30MC, but on bands 52MC and above such stations may be logged, once only per band, for one point. See example given. VK1 and VK2 also VK5 and VK6 are considered to be the same areas for scoring purposes.

5. A station heard may be logged once on phone and once on CW for each band.

6. Club receiving stations may enter for the Receiving Section of the Contest, but will not be eligible for the trophy. However, if sufficient entries are received a special award may be given to the top Club receiving station in Australia. All operators must sign the Declaration.

AWARDS:

Certificates will be awarded to the highest

EXAMPLE OF TRANSMITTING LOG

DATE/TIME G.M.T.	BAND	EMISSION	CALL SIGN WORKED	R.S.T. No. SENT	R.S.T. No. RECEIVED	V.H.F. BONUS	POINTS CLAIMED
Aug. 1965	7MC.	A3(a)	VK5PS	58002	VK6RU	—	2
14 0810	7MC.	A3(a)	VK6RU	59007	VK7EJ	—	5
14 0812	7MC.	A3(a)	VK4ZAZ	56010	VK5ZDR	25	28
14 1035	52MC.	A3	VK3ALZ	59025	VK3QV	—	1

EXAMPLE OF RECEIVING LOG (VICTORIA S.W.L.)

DATE/TIME G.M.T.	BAND	EMISSION	CALL SIGN HEARD	R.S.T. No. SENT	STATION CALLED	V.H.F. BONUS	POINTS CLAIMED
Aug. 1965	7MC.	A3(a)	VK5PS	58002	VK6RU	—	2
14 0810	7MC.	A3(a)	VK6RU	59007	VK7EJ	—	5
14 1035	52MC.	A3	VK4ZAZ	56010	VK5ZDR	25	28
14 1040	52MC.	A3	VK3ALZ	59025	VK3QV	—	1

invalid contact is made it must be shown but no score claimed.

Entrants in the Open Section must show CW and phone contacts in numerical sequence.

12. The Federal Contest Manager has the right to disqualify any entrant who, during the contest, has not observed the regulations or has consistently departed from the accepted code of operating ethics.

The Federal Contest Manager also has the right to disqualify any illegible, incomplete or incorrectly set out logs.

13. The ruling of the Federal Contest Manager of the W.I.A. is final and no disputes will be discussed.

AWARDS: Certificates will be awarded to the top-scoring stations in sections (a), (b), (c) of Rule 1 above in each call area. VK1 and VK5 will count as separate areas for awards. There will be no outright winner for Australia. Further Certificates may be awarded at the discretion of the Federal Contest Manager.

The Division to which the Trophy will be awarded shall be determined in the following way:

To the average of the top six logs shall be added a bonus arrived at by adding to this average the ratio of logs entered to the number of State Licensees (excluding Limited Licensees), multiplied by the total points from all entries in sections (a), (b) and (c) of Rule 1.

VK1 scores will not be included with VK2 nor VK6 with VK5.

Average of top six logs plus

No. of Logs entered X Total Points from all entrants in sections (a), (b), (c)

No. of State Licensees excluding Limited Licensees

Acceptable Logs for all sections shall show at least five valid contacts.

scorers in each call area. Further Certificates may be awarded at the discretion of the Federal Contest Manager.

TRANSMITTING OPEN—VHF-UHF ONLY (Section E).

ADDITIONAL NOTES:

1. This section is being introduced this year in answer to the request by many amateurs that provision be made for participation by Limited Licensees and other VHF-UHF operators. It is in the nature of an experiment and because of this logs entered for Section (e) will not be considered in the determination of the Trophy winner.

The response to this innovation by those it is intended to interest and comments from all interested amateurs, other additions and changes may be incorporated in future contests.

2. All intrastate contacts in the bands above 50MC will count one point. Interstate contacts will be valued as in the table for MF-HF contacts, including the 25 bonus points for the first contact with other call areas.

3. Entrants may submit logs for one Transmitting Section other than section (a) and interstate VHF-UHF contacts may be included in both logs.

4. Logs must be set out in the standard manner prescribed.

AWARDS:

Certificates will be awarded to the highest scorer in each Call Area.

(a) The Federal Contest Manager emphasises the need for strict observance of Rule 9 in the Transmitting section and Rule 3 in the Receiving Section.

(b) Note that the use of GMT is required in accordance with the W.I.A. policy to encourage the use of G.M.T. by Australian Amateurs.

SCORING TABLE

To	VK0	VK1-2	VK3	VK4	VK5-8	VK6	VK7	VK9
From VK0	-	6	6	6	6	6	6	6
" VK1-2	6	-	1	2	3	3	4	6
" VK3	6	1	-	3	2	3	4	6
" VK4	6	1	2	-	3	6	5	4
" VK5-8	6	2	1	3	-	3	4	6
" VK6	6	1	2	4	3	-	5	6
" VK7	6	2	1	4	3	3	-	6
" VK9	6	1	2	3	4	5	6	-

NOTE: Read table from left to right for points for the various call areas.

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LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

THIRD STATION FOR UNI. OF NSW

The third station of the University of New South Wales in Sydney has commenced operating on their common frequency of 1750KC, following the success of the Sydney and Wollongong stations in this unique means of education.

THE University of New South Wales announced recently that the new University Radio would be opened in Newcastle in July and would augment the present Sydney and Wollongong stations to aid in teaching by radio at home. The transmitting station at Newcastle will be a branch of VL2UV which commenced in 1961. The second station at Wollongong was established in 1963. Both these stations have continued to provide short courses in both post-graduate and extension type subjects, and many people have made full use of the broadcast lectures, and of the notes issued in association with them, to further their knowledge on a wide range of subjects.

The new station at Newcastle will have its transmitter located at the Waratah reservoir and, according to Professor Baxter of the University of New South Wales, transmission for the start will be for one evening a week. The first series to be broadcast will be called "Medical School of the Air," followed by a series on income-tax law aimed at the business and professional man. The Sydney station has expanded its broadcast hours and range of subject matter, and there were over 3,000 radio enrolments last year.

The power of Sydney and Wollongong is 300 watts and the Newcastle station 150 watts.

The Sydney station is on the air weekdays from 0800 to 1200, except Tuesday and Wednesday from 1100-1200 to allow the frequency to be used by Wollongong, and on Thursday 1000-1200 for the Newcastle station. The Wollongong station is on the air on Wednesday 1000-1200 until August 16 when the schedule is reduced to 1100-1200 GMT. Reception reports from listeners have been received from all States in Australia as well as New Zealand.

RADIO MALAYSIA STATIONS

Two new frequencies for Radio Malaysia have been noted in the 60 metre band and both at good level. The new Radio Malaysia-Singapore outlet using 5035KC has news in English at 1130GMT, and the program which follows is all in English.

Kuala Lumpur outlet of Radio Malaysia in the Malay language has been noted, from a new 10KW transmitter on 4790KC, and the station was heard to identify in Malay at 1045GMT. At 1100 the usual interval signal of Radio Malaysia was played followed by a march and news. The Radio Malaysia outlet in Kuala Lumpur on 4985KC has a program in English and is also giving good signals at 1100GMT.

CE597 WELL RECEIVED

The new CE597 in Santiago, Chile, using 975KC and the power of 1000 watts, has been received at good strength from opening at 1000GMT and at 1155GMT when carrying a news bulletin in Spanish. The station is in chain with the widely reported CE960 on 9600KC which opens at 1000 and closes at 0500GMT, and uses a long announcement in English in which a

request for reports is made. CE960 has a power of 10KW.

Verification from the station (after 8 months) is by a card, and this shows the station slogan "Radio presidente Balma-ceda" in red. It also refers to the two short wave stations and medium wave station CB130 on 1300KC. The station address is Casilla 13650 Santiago. With the verification card came a tourist book on Chile showing some of the scenic attractions and hotel details.

MONTREAL USING 11725KC

Radio Canada in Montreal in its transmission to Latin America has commenced using the new frequency of 1172KC, which replaces 11760KC. The transmission opens at 2300GMT in English, Portuguese at 2330 and Spanish at 2400 with sign off at 0045. The transmission is also carried on 15190 and 9625KC.

A new verification card has been issued by the Canadian Broadcasting Corporation in Montreal to verify reports to Radio Canada. This depicts the new Canadian flag, the card is oblong with three panels, red, white and red, and the centre white panel has the red maple leaf imposed on it. This card is most effective, with no printing over the flag. Verification details are on the reverse side.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are in GMT, add 8 hours for Perth, 10 hours for Sydney, and 12 hours for Wellington time. All frequencies are in kilocycles.

BRUSSELS ON 9615KC

A new frequency of 9615KC has been observed in use by the Belgium Radio and Television Service, when carrying its transmission to Latin America from 2115GMT in Flemish. The station has news at 2130, a sports newsreel program at 2140, and identification at 2145. This station is also assigned to use 6140 and 9740KC, and the previous channel of 9600KC appears to be replaced by 9615KC, the latter apparently having given poor reception of the Belgium program in South America. The Brussels station uses the mailing address of the Belgium National Broadcasting System, P.O. Box 26, Brussels, Belgium, and verification is promptly received in the form of an attractive QSL card and letter. The station in former years was known as the "Goodwill Station," but its cessation of English broadcasts some months ago makes it less widely heard by listeners.

AUSTRALIAN RADIO DX CLUB

The establishment of the Australian Radio DX Club will interest our Australian readers, as the new organisation has been established from the former Branch of the New Zealand Radio DX League in Sydney, and also incorporates many members of the New Zealand DX Radio Association.

The Australian Radio DX Club is expected to commence to operate in August and its official publication is "Australian DX News." The address of the Club is 103 Edinburgh Road, Castlecrag, New South Wales. A sample copy of the Club's magazine can be had from the above address. Editor of the "Australian DX News" is Robert Ronai.

BBC EXPANSION

The recent change in title from the BBC General Overseas Service to the BBC World Service is a recognition of the expansion in radio services from London. It is estimated that 100 million new radio listeners are added to the radio audiences each year with the rapid expansion of radio listening in Africa, Middle East, Asia, Latin America and the West Indies; due mainly to the transistor radio, its cheapness, and the intense interest of the new developing countries in radio broadcasting.

Recently Mr Edward Bowmont, the Chief Engineer of the BBC External Services, reviewed the BBC expansion in short wave broadcasting. The first experiments leading to Empire broadcasting commenced in 1923, with transmissions from Chelmsford on 24 metres, were aimed at determining whether a general listening audience existed as well as the radio amateur.

This led to the establishment of the Empire station at Daventry.

The BBC commenced regular transmissions in November 1932, using two 15KW transmitters. In 1937 the Empire Service was given a boost with the Coronation of King George VI, which included the introduction of three high powered transmitters.

In 1939 at the outbreak of War the BBC had eight transmitters, with three more under construction. In mid 1940 a new station was built in southern England with four high powered transmitters, and two more new stations were built in Britain in 1942 and 1943 adding another 24 transmitters to the BBC services. Further transmitters were installed at existing BBC medium wave sites to bring the total up to over 40 transmitters.

Studio expansion at Bush House commenced in 1945 and was aimed at the concentration of all overseas transmissions in the one building. Bush House now contains 38 studios and overseas broadcasts are made in over 40 languages. Also, relay bases on medium and short wave are being brought into service in Cyprus, Malta, Liberia, Singapore and Perim Islands to give better coverage to specified audiences.

PRAGUE RADIO MONITORS

The announcement by the Czechoslovakian Radio of the establishment of a Radio Monitors Club follows the recent success of the Radio Canada Short Wave Club, Portugal DX Club and the Hungarian DX Club. All these organisations are associated with their stations which require five reception reports from listeners to become a member, after which members must report regularly on the reception to maintain their association with the organisation. Radio Canada is the only organisation of this type which merits the interest of readers, as its program each Saturday at 0745GMT on 9790 and 9630KC includes many interesting features, as well as supplying club members with competitions and information of benefit to their hobby.

The newly announced Prague Club is on the same lines, overseas listeners must send in seven reception reports within a year and number them.

A certificate of membership is given, and in return the station receives from its listeners in many parts of the world a regular source of information on the reception of its transmissions. However, there seems no incentive to the listeners to report on their reception of the Prague station.

Further details on the Radio Prague Moni-

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tors Club can be had from the station, and this also is the case with the Radio Canada, Radio Portugal and Radio Budapest DX Clubs.

PJB USING 11880KC

Reception of the Trans World Radio station at Bonaire, Netherlands Antilles, has been reported frequently in these pages, and the reception of the new scheduled transmissions after a long period of testing, means that the broadcasts are now at more regular times and on set frequencies. This is the case for the service to North America, which is on the air from 0335 to 0350GMT daily on 11880KC. The station is now using the slogan "The International Sound of the Caribbean." It is heard well in this program, which includes news and sacred music. When closing, the station invites its listeners to tune in again "tomorrow evening at 11.35 p.m. Eastern Standard Time or 11.35 p.m. Bonaire time," and also states that the station is now closing to reopen in five minutes with a multi-lingual program in the 31 metre band, which opens in Russian. No exact frequency is given for the service from 0400GMT, but 11880KC, which also is only referred to as the 25 metre band outlet, gives good signals in New Zealand.

LATIN-AMERICAS ROUNDUP

Over the period March to September, Latin American signals in the 49 and 60M bands in our evenings offer excellent reception, and in fact most stations can be tuned at 1000GMT onwards throughout the year on these bands. This list of the most interesting stations is compiled from information from some of our readers, Steve Thurlow, Cabramatta, N.S.W.; Bob Padua, Melbourne, Vic.; Fred Kluth, Dubbo, N.S.W.; and our own observations: 4775KC HKW "La Voz de Maria" Bogota. Identification announcement 1115GMT; 4845 HJGF Radio Bucaramanga, Colombia. Fair

signal at 1117, often identifies; 4895 HJCH "La Voz de la Victor" Bogota. Heard from 1030; 4940 HCXZ1, Radio Nacional, Quito, Ecuador. News in Spanish 1200; 6000 Radio America, Swan Island. Opens 1000 with English announcement; 6030 HJZ1, Radio Nacional, Bogota. News 1130 preceded by March. 6040 HJCB La voz de Telem, Colombia. Fair signal at 1055; 6082 OAX4Z Radio Nacional, Lima, Peru. Good at 1145 after Radio New Zealand leaves the frequency; 6105 OAX6F Radio Nacional, Tacna, Peru. Fair at 1300 with news. 6120 4VE Cap Haitien, Haiti. Fair at 1100 with gospel program; 6125 CP15 Radio el Condor, La Paz, Bolivia. Fair signal at 1200; 6130 YNI Radio Leon, Nicaragua. Fair at 1125 and with musical program; 6140 YNWA Radio Mundial, Managua. Nicaragua. Marches and identification 1200; 6130 HJCT Radio Nacional, Institute of Radio and Television, Bogota. Heard with 3 note chimes and news 1200; 6200 YNIN Sonota, Nicaragua, "Radio del Norte" news at 1200 and music; 6205 TIGHB Radio Reloj, San Jose. Strong signals at 1200.

NEW TRANSMITTERS FOR FEBC

A test transmission from the Far East Broadcasting Company in Manila has been observed in the past few days on 11920KC at 0630 to 0800 and, from announcements, the transmitter is a new 50KW one. Details from the FEBC in Manila show this is the first of four new 50KW transmitters to be installed, and the station expects to have all in operation within 18 months. The tests on 11920KC are carried on the north south beam with Japan and Indonesia as the target areas. FEBC Manila states that full power of 50KW was not reached for the initial tests, due to power supply problems to the transmitter buildings but, by the time this reaches our readers, the full power of 50KW will be in use.

beginning of each English transmission. Reported by Ernest Suffock of South Australia, who received this information from Radio Nigeria.

TARAWA RADIO in the Gilbert and Ellice Islands has moved from 6055 to 4912KC with 2KW of power, and has also added to its transmission in Gilbertese. Heard formerly on Wednesday and Friday, 0430-0600 only, it now seems to be on the air each day and has been heard closing at 0600 with announcements in Gilbertese and English by a lady speaker, followed by the National Anthem signals are best after 0555 when HCM1 in Quito leaves the frequency of 4910KC.

SAUDI ARABIAN Broadcasting System is reported to be using the new frequencies 1528 and 11765KC, and the new transmission is on the air 0530-0630. The programs are in Arabic except on odd days when Arabic-German lessons have been heard.

PARIS has stepped up its English transmissions. As well as the reported service 0515-0530 on 15445, 11905 and 9550KC, the station has English at 13000GMT on 11850, 15245 and 21580KC. A program is heard at 2000GMT on 6175KC with the service directed to Europe.

ETHIOPIAN station ETLF in Addis Ababa has been heard between 1435-1455 with a program in Arabic on 9705KC. ETLF, the Radio Voice of the Gospel, has also been heard on this frequency at 1900GMT with its usual English transmissions for listeners in East Africa.

BELGRADE in Yugoslavia is on the air in English from 1830-1900 on 6100 and 7200 KC; 1530-1630 on 15240, 11735, 9505KC; 2200-2215 on 9505, 7200 and 6100KC, according to the station's schedule to hand.

MANILA station DZF2 of the Far East Broadcasting Company, is heard testing at good level on 11920KC at 0630 in the transmission for Japan, Malaysia and Indonesia. Some side interference from HCJB, using 11915KC, has been noted on this test transmission. The Manila station has its special transmission of the Pacific Hour for reception in New Zealand and Australia, and this transmission at 0900-1000 is carried on 11855 KC. On Monday at 0915GMT the "Short Wave Mailbag" program is heard on 11855KC with answers to letters from FEBC listeners. Reports to this and other FEBC transmissions should be sent to P.O. Box 2041, Manila, Philippines.

BONAIRE continues to be heard on a test basis and the last frequencies to be tested were 6080KC from 0115-0155, 0200 onwards, with announcements in several languages and request for reports. It is

(Continued overleaf)

FLASHES FROM EVERYWHERE

BERLIN International in East Germany is using a new 31M frequency for its service to North America in English from 0445 to 0515GMT. The station is using 9770KC but, in this area, the frequency suffers severe interference from the Voice of America transmitter using the same frequency.

LEBANON has made a frequency change in its service to North America from 0130 to 0400 and dropped from 9760 to 9710KC. The channel is not a good one as this is a long-established channel assigned to the Rome Radio. The Beirut station opens at 0130 in French, 0200 in Arabic, 0230 in English, 0300 in Arabic, and 0330 in Spanish. The frequency is covered by Rome Radio to 0325 and from this time to sign off the signal is good, as reported by David Carr, of Auckland, N.Z.

FRANCE has been noted in a new transmission in English at 0515GMT, on using 11906KC. The station has news and commentary in the 15-minute program which, it is presumed, is for listeners in Africa and Europe.

ECUADORIAN station Radio el Progreso has been observed 4705KC at 0600 when the station signs off. This station has been reported from Europe and also at weak level in New Zealand.

BOLIVIA is the site of a new station known as Radio Universal, with the mailing address of P.O. Box 232 in La Paz. The station uses 5015KC, according to the World Radio Handbook bulletin.

ALGIERS has been heard in the 49M band on the new channel of 6050KC with news in French at 0730, 1700, 1800 and 2000GMT. The station is best received in the transmission at 1900 and 2000 hours, as the first transmission at 0730 finds the frequency blocked by HCJB in Quito. Swiss DX Session reports that good signals can be heard in Europe on all transmissions.

BUDAPEST in Hungary has English transmission to the United Kingdom from 1900 to 2000 on 7305 and 9833KC; 2200-2230 on 6234, 7215, 7305 and 9833; 2330-2400, 6234KC. To North America 0030-0100, 0130-0200 on 6234, 7305, 9540, 9833KC; 0300-0330, 0330-0400, 0430-0500 on 6234, 7215, 7305 and 9833KC.

NIGERIA in its overseas services from Lagos has extended its External Service a further two hours. The station is on the air 1300-1600 on 11900KC; 1600-2200 on 15255; 1700-2200 on 1190; and in these transmissions English programs are from 1500-1600, 1700-1900 and 2100-2200, with full news bulletins at the

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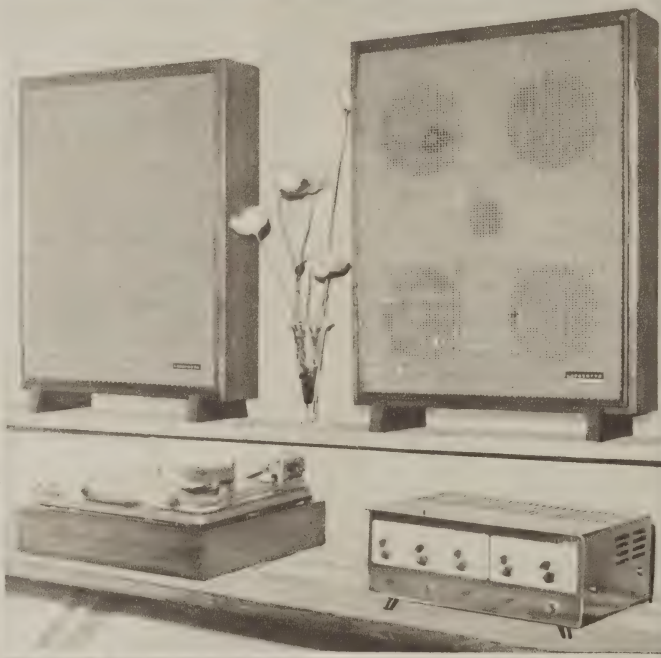
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at present relaying the program of Radio Netherlands from 2200 to 2220GMT. on the new frequency of 15220KC. The program is in English and Dutch. Another new frequency, 9590KC, is used for English, Dutch and Spanish from 0130 to 0450GMT, and the transmissions are directed to North and Central America.

TAHITI is being heard opening at 1615GMT on its shortwave and broadcast band frequencies, 1400KC on BC providing good reception. The present schedule of the station, according to August Bulbi of California, is 1615-1815, 2100-2300 and 0300-0800 when 11825, 6130 and 1400KC are used, and on Sundays only 2000-2300. Radio Tahiti on 11825KC is heard with Tahitian program to 0600 and then to sign off at 0800. The transmission is in French.

CAIRO, with the transmission "The Voice of the Arabs," has increased the number of transmitters in use from three to four. The service in Arabic is heard from 0400 to 2400 on 7050, 9490, 11745 and 15100KC. The new frequency of 15100KC is used by the new transmitter of the Egyptian Radio.

PYONGYANG in North Korea has shortened the transmissions to the Middle East and Africa and is now on the air in English 1900-2000 and French 2000-2200, when the frequencies are 6540, 7580, 9875 and 11750KC. Another session in English 0400-0500 is on 14520 and 15520KC.

CLANDESTINE station which has operated from the days of the Spanish Civil War and known as "Radio Espania Independencia" has at last been located as broadcasting from Roumania. The transmissions, which have long puzzled listeners in this area, are now heard 7690, 8600, and 10100KC, and heard 1630-2300, and also at 0600GMT which gives best reception here.

BROADCAST, TV DX

Thailand—Transmission of the English half hour over Radio 20 in Bangkok, makes identification of the Thai Station easy. The signals, on 1520KC with 10 KW, are well received from 1500 to 1530 GMT. The Thai stations are notorious for frequency moves and the lack of details about medium wave stations in the country, but Radio 20 and the Television Radio station on 1500KC are the most consistent heard, the latter closing in English at 1700GMT.

The program of Radio 20 gives English news at 1500, then a documentary at 1510 and weather at 1520 with light music to 1530 when the station program is again in Thai. The station invited listeners to tune in tomorrow at 10 p.m. Bangkok time, (1500GMT) for another English program.

Siberia—The Radio Moscow relay station in Siberia is being used to carry the English transmissions to Australia and New Zealand on broadcast band as well as on short wave and three frequencies, 548, 629 and 1250KC are used in the various transmissions for morning and evening reception in this area. 2130-2200, 11690, 9540, 9610, 7180, 7280, 6060, 1250 and 548KC.

1130-1200, 11690, 9540, 7280, 629KC.
1230-1300, 11690, 9540, 7280, 629KC.
1330-1400, 11690, 7280, 5960 and 629KC.

The Moscow Mailbag session in which letters from listeners are answered is broadcast at 1145 and 1245 on Saturday.

TELEVISION DX

The reception of television signals over any distance is unpredictable and not regular in any sense, but from time to time readers report the signals and picture of television stations over some long distances. This is the case with Allyn Backhouse, of Normanhurst, Sydney with reception of the Townsville, Queensland, station on Channel 3. The station ABTQ3 is over 1000 miles north of Sydney and overpowered NBN3 (Newcastle, N.S.W.), on the same channel. Reception was from 0545GMT onwards, and was visual only.

ANSWERS TO CORRESPONDENTS

When writing to us:—

- Please give your name and full postal address, including the State . . . N.S.W. &c.
- Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.

FM TUNER

C.E.G. (North Balwyn, Vic.), asks whether we would like to describe an FM tuner covering the TV channel frequencies to allow recording of good quality sound. He follows on to mention that recording from the audio stages of his TV set leaves traces of distracting noises.

It is probable that these distracting noises are remains of picture information feeding into the sound system. Building a separate tuner for the sound channels may help to obviate this trouble, but we feel that the demand at this stage would be too small to warrant describing an FM tuner with such a wide frequency coverage. However, we will keep the idea in mind and see whether other readers have a similar need.

BASS AMPLIFIER

M.C. (Bris., Qld.), writes asking for an estimate of the construction costs for a bass guitar amplifier.

We regret that we are unable to give price estimates for our projects as these are likely to vary considerably according to quality of parts, source of supply, etc. In this instance we have not described a suitable amplifier and could not therefore supply either plans or estimates.

TAPE GADGETS

A.S. (Albany, W.A.) has sent in brief details of tape gadgets which were described in the February issue of the magazine "Practical Electronics," which he would refer to readers having problems similar to that of H.F. published in these columns for April. He also compliments us for our "Basic Radio Course" series, which he considers to be an excellent introduction to the subject for beginners.

Many thanks for the information, A.S., and we will hold it for H.F. should he be unable to refer to the magazine article itself. The mixer circuits are of interest, although they are not without serious limitations regarding interaction between inputs, etc. Thanks for your comments regarding the Basic Radio Course.

MUSICAL TUNING

J.Mc.D. (Bowden, S.A.) writes particularly to thank us for the article on musical tuning in the June issue. He says that he has been reading the journal for longer than he cares to remember and always enjoys the articles by Calvin Walters and The Serviceman. He likes the new name and the general format of the current issues.

The article on musical tuning does appear to have "hit the spot" in a surprising fashion. We are glad to know that you are pleased with the results from your organ built up from one of the Electronic Organ Company kits. We will pass on your kind wishes to The Serviceman and to Calvin Walters. Unfortunately, Cal. is finding the

going a bit tough, these days, with the pressure of other activities and he may not be able to contribute articles as regularly as in the past. However, we plan to fill the pages, as necessary, with articles by other writers at about the same technical level.

MODEL CONTROL

B.F. (Eleebana, N.S.W.) says he felt that our "Simple Model Control System" (Dec., 64) did not go far enough and he would like to see something with a range of several hundred yards.

We were under no illusions about the limitations of the system described. However, we felt that it would be worthwhile, if only to provide a basis for experimenting with controlled circuits and simple gadgets, either of the wheeled variety or boats on small pools. On this basis, it is serving its purpose and emphasising that a good deal of mechanics has to be devised to utilise the signal impulse. We have not forgotten the matter of a true radio control system.

RADIO CONTROL

D.M. (Brooklyn Park, S.A.) says he has found much help in the pages of this journal and especially appreciates the record review pages. Having had good success with our simple remote control system, he wants now to go on with a full-scale radio control system.

Thank you for your appreciative remarks about the journal. We do try to be objective and accurate in our record reviews, as indeed with books and products. We had a special contributed series on radio control all lined up but something went wrong at the last minute. We haven't forgotten the subject, but we have to organise things all over again!

SHORT-WAVE CONVERTER

G.P. (Forbes, N.S.W.) says he has been reading this journal for 10 years or so and finds it much to interest him. He suggests that we could follow up our recent short-wave converter with a bandspeed unit especially designed for listening to the amateur bands. If something could be done to facilitate SSB reception, so much the better.

Thank you for your suggestion and we have put it aside for a closer study. The amateur band requirement should not be too hard. Provision for SSB could be a tough one

and might involve getting to work inside the basic receiver, which most people would probably not want to do, especially if it happened to be a commercial portable or a car radio.

TRANSISTOR PROJECTS

I.McK. (Heathmont, Vic.) would like to see some discussion in forthcoming issues of "ELECTRONICS Australia" on transistorised amateur equipment and also an 11-inch TV receiver.

Thank you for your suggestions. We may be able to include some articles along this line from time to time. About the 11-inch TV receiver, we are not too sure. The economic attraction of building your own TV set is virtually non-existent and there may be serious doubt about the worth of such a project.

"ALVIN GENERATOR"

J.S. (Vaucluse, Sydney) asks whether we can direct him to details of a device which can double the frequency of all sounds fed to it. He thinks it is called an "Alvin Generator" and is used for the production of Chipmunk records.

As far as we know, we have never published anything on such a device, although heterodyne and rectification techniques can modify the frequency content of sounds fed into them, as happens with SSB transmission and reception. If you want to produce Chipmunk songs or speech, simply speak into a tape recorder running at a slow speed and try to mouth all your syllables at half speed. When the tape recorder speed is doubled, the rate of speech comes up to normal but raised in pitch by an octave. Musical accompaniment can be provided in the same way but played at half speed an octave down. Alternatively if you can double record, using two machines or a four-track machine with listen/record facilities, you can record a normal accompaniment at normal speed, then play it back at half speed, at the same time recording the vocal or interspersed speech at the slow tempo, as mentioned earlier. When replayed together, the music reverts to normal but the vocal jumps an octave, is compressed to the correct tempo and, of course, contains the quaint results of trying to mouth words at half tempo. Try it; it's good for a laugh.

"ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service.

Conditions governing this service are set out below:

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia", Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the 2/ fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at 2/ PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in. x 8in. glossy print, postage 9d extra.

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

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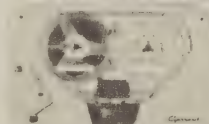
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TECHNICAL BOOKS AND PUBLICATIONS

SELECTED SEMICONDUCTOR CIRCUITS, by the Editorial Staff of Tech-Press Publications, Brownsburg, Indiana. Soft covers, 6in x 9in, 80 pages. Circuits, some text. Price in Australia 13/6 posted.

A little reference volume of useful transistor and diode circuits for the amateur, experimenter, hobbyist and technician. Each circuit is accompanied by very brief text and notes. Some of the transistors specified may not be available locally, but near equivalents should be available in many cases.

Perhaps not a book of wide appeal, but one which may be of interest to those having reasonable experience who need only the circuit and brief details of a project. It may also be of use to designers as a guide to design trends.

Our copy came from McGills Authorised Newsagency, 183 Elizabeth Street, Melbourne. (J.R.)

MINIWATT ELECTRONICS HANDBOOK 1, published by the Miniwatt Electronics Division of Philips Electrical Pty. Limited. Hard cover, 5 by 6½ inches with approximately 484 pages. Australian price 25/.

Philips have assembled in this handy size book data and graphs for the Australian Miniwatt preferred range of Radio Receiving Valves, Television Receiving Valves, Valves for Audio Applications and Television Tubes. This information includes physical dimensions, basing connections, typical operating conditions, maximum ratings, characteristic curves and application instructions.

In the early pages of the book, a cross-reference of type numbers is given and a valve classification guide which allows the selection at a glance of the preferred valve for the application required.

A handy reference book for engineers, technicians and students. Our review copy came direct from the publishers and copies are obtainable from all Philips branches and leading booksellers. (K.W.)

NEWNES PRACTICAL HANDBOOK SERIES, "Industrial Transformers," by M. A. Spurway; "Electric Motors," by R. Rawlinson; "Industrial Switchgear," by E. A. Reeves; and "Cable Jointing," by R. Thompson. Hard covers, 7½ by 4½ inches, over 100 pages in each title, well illustrated, and complete with tables. Published by George Newnes Ltd., London. Australian price 16/ each plus post and package 1/3 each.

In the handbook of Installation and Maintenance of Industrial Transformers the author points out the necessary steps to ensure long, trouble-free service from industrial transformers, of ratings up to about 1,000KVA and 33KV, together with auxiliary equipments. He also shows how to choose the site for a new installation and deals with installation work and preparation for service.

This book includes many photographs of typical maintenance and installation procedures. Some of the hints, those obvious when pointed out, are applicable in other fields. One example is the idea of connecting a spanner by a short cord to the operator's wrist. How many times have one of us dropped a spanner in an inaccessible spot?

Under the second title of this series, Installation and Maintenance of Electric Motors, the practical aspects of the subject are dealt with in relation to the factory engineer. Discussed are the factors to be considered when selecting a motor and its

associated gear, the inspection, testing, drying out and installation of the chosen equipment. Also described is the subsequent maintenance of the equipment in full working order.

While the electric motor today is used in applications from electric shavers to submarines, the author deals with the heavy industrial motor only in this publication. As these motors are used in conditions which are highly variable, a lot of practical background must be, and is, covered in the text.

Installation and Maintenance of Industrial Switchgear covers the procedures for installing and maintaining industrial switchgear falling within the range of 415 volts to 11 kilovolts. All types of industrial switchgear within the voltage limits mentioned, whether air-break, oil-break or air-blast, are covered.

As mentioned by the author, it would be impossible in such a small book to give other than broad details of the subject matter, but the basic principles as outlined will find ready application by the factory engineer. In the maintenance section of the text some very clear illustrations are given of typical faults and the point where components may be repaired or replaced is discussed.

The final title of the series, Cable Jointing, details the practical skills and proce-

dures required for joining and connecting cables and fitting any necessary mechanical protective enclosures. The handbook covers cables up to 11KV.

Jointing is a highly specialised field and the author has treated the subject in fine detail. Properties of tin-lead alloys are discussed and such items as soldering of aluminium sheathed cables are covered in full. Profusely illustrated throughout the text, this book seems ideal for the joiner who wishes to further his knowledge in this field.

Each of these handbooks show merit as a reference book in their specialised fields. The texts are presented in an easily assimilated form and contain plenty of practical knowledge. Our review copies from Technical Book and Magazine Co. Pty. Ltd., 295-299 Swanston Street, Melbourne. (K.W.)

HIFI TROUBLES—How you can avoid them; how you can cure them. By Herman Burstein. Stiff paper cover, 160 pages 5½ x 8½in, freely illustrated. Published by Gernsback Library Inc., New York. American price 3.95 dollars. (Our copy direct from publishers.)

The author of this text has set himself a tough assignment — to write a book presenting "technicalities without tears" to readers who, it is assumed, have no prior knowledge of the subject. The ever-present danger, in such a book, is that the text will degenerate into a recitation of three-quarter truths, the remaining 25 per cent being represented by cases which don't conform to the usual pattern of things on which the explanations are based.

Undoubtedly some criticism of this sort could be levelled at this new book but Herman Burstein, a regular contributor to

100 Years of History

FROM SEMAPHORE TO SATELLITE, ITU 1865-1965.

343 pages, 11 x 8½ inches, stiff cloth cover, embossed. Published by the International Telecommunication Union, who supplied the original copy for our review. Available from the Publications Service of the ITU, Place Des Nations, 1211 Geneva 20, Switzerland. Price 40 Swiss francs (US \$5.50 dollars).

In the editorial of our May issue, we commented on the fact that, this year, the International Telecommunication Union celebrates its centenary. To mark the occasion, they have issued this very excellent book, as illustrated.

And there is more to the title than its alliteration; it is strictly factual.

The book opens with a discussion of the very real communication problems in the seventeenth and eighteenth centuries, their methods of signalling and the gradual development of the visual telegraph system. The text is illustrated with sketches from the period.

This leads naturally into the evolution of electrical telegraphy, the earliest date mentioned being 1753, with a proposal for an adaption of electrostatic phenomena. The part played subsequently by men like Cooke, Wheatstone, Morse and Vail is mentioned, as also the stimulus supplied by railway systems and newspapers, with their particular requirements for rapid communication.

So the story continues, through under-sea cables to telephony and the modern telephone.

Section 2 of the book has to do with Radio. It goes back to Joseph Henry who, in 1842, discovered the oscillatory character of electrical discharges. From such beginnings, it traces the development of early marine wireless, broadcasting, radar and wartime communications, microwave and modern television.

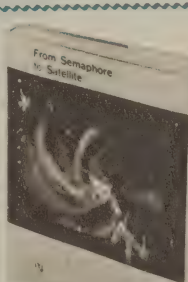
The final section of the book is devoted to the I.T.U. itself, its various functions and committees and its role in present-day communications—with a good deal of emphasis on space research. As an illustration of the social significance of modern communication, a map shows the communication and Flying Doctor network serving inland Australia.

Appropriately, this is an international story, although it is too much to hope that the contents of any book will please every potential critic, in terms of what has been put in and what has been left out.

But, for this reviewer, the book has been put aside for attention during the next available leave period. It's the kind of book that invites reading, quite apart from its very considerable reference value.

It is superbly produced, with high quality paper and binding and open, attractive layout, largely made possible by the large format. Illustrations, taking up probably more than half the total space, range from early drawings and patent specifications, through topical and relevant cartoons to large, up-to-the-minute pictures, including one of the telescopes at Parkes, N.S.W.

Readers desiring a copy of the book may have to order it direct from Geneva. No information is to hand regarding local stocks. (W.N.W.)



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USEFUL ELECTRONIC SHOP HINTS edited by "Electronic Technician" magazine staff—crammed full of practical, helpful and timesaving hints. Illustrated 24/6 (Post 11d).

BASICS OF FRACTIONAL HORSE-POWER MOTORS AND REPAIR by G. Schweitzer—to assist in locating faults after each motor has been discussed there is an accompanying troubleshooting chart for that motor. Illustrated 49/ (Post 11d).

HOW TO LOCATE AND ELIMINATE RADIO AND TV INTERFERENCE by F. D. Rowe.—A practical book: tells the reader what to look for, what to do, and how to do it. Illustrated 36/ (Post 11d).

HOW TO SERVICE TAPE RECORDERS by C. A. Tuthill—explains the types of circuits, drive mechanisms, troubleshooting, and repair. Illustrated. 36/ (Post 11d).

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audio magazines, is well qualified to write on hi-fi matters. A sampling of parts throughout the book brought to light nothing with which I could quarrel; on the contrary, I gained the impression of a book well written.

As implied earlier, it is intended primarily for people who have bought high fidelity equipment for the pleasure it affords but who now want to know something about its operation, even to the stage of being able to track down hi-fi troubles such as hum, hiss distortion, etc.

Chapter One is for the potential malcontent and explains "Why we have audio troubles."

Chapter two and three seek to reassure the reader by explaining how he can pursue his activities with few tools and some logical deduction.

Chapters four to nine inclusive discuss individual problems which can occur, hum, noise, distortion, weak sound and so on.

Stereo has its own special chapter, the book concluding with some practical advice about building kitsets — potentially a very useful subject.

It's all very straightforward but the reader who can successfully tuck the contents of this book under his hatband can move into the next class. (W.N.W.)

★ ★ ★
PROGRESSIVE PROBLEMS IN ELECTRICAL ENGINEERING 1, by F. B. Lockwood and R. Dunstan. Soft cover, 54 by 81 inches, 124 pages well illustrated and containing many formulae. Published by Norman Price (Publishers) Ltd., London. Australian price 15/ plus 1/3 post and package.

A further copy of the above publication is to hand from the Technical Book and Magazine Company Pty. Ltd., 295-299 Swanston Street, Melbourne. For a detailed review, see our March, 1965, issue.

★ ★ ★
WORLD RADIO-TV HANDBOOK, 1965. Soft covers, 61 by 81 inches, 302 pages. Published by World Radio - Television Handbook Co. Ltd., Sundsvvej 6, Hellerup, Denmark. Price in Australia 39/6 plus 1/9 post and packing where applicable.

The 19th edition of a now widely known publication, which rightly claims to be "the authoritative reference of international radio and television." A very comprehensive source of information concerning domestic and overseas radio, shortwave and television stations throughout the world.

Probably an essential reference for the DX fan and short-wave listener, at quite a moderate price. We know of no other publication giving this account of information on international broadcasting.

Our copy came from the Technical Book and Magazine Co., of 295-299 Swanston Street, Melbourne.

★ ★ ★
ANODEAL Sales Division have available two new condensed component catalogues, one being for picture tubes (No. 7) and the other for semi-conductor devices (No. 10). Included in the latter are details of silicon transistors and reference diodes, also integrated circuits. (Electronic City, 443 Concord Road, Rhodes, N.S.W.).

MINIWATT DIGEST for July, 1965 (Vol. 4, No. 10) has articles on the new Plumbicon television camera tube, an electronic AC voltage level detector, controlled avalanche diodes and thyristors and a transistorised speed level detector. New products announced are a vane switched oscillator for digital use and a 25in television picture tube. (Miniwatt Div., Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W.).

INDUSTRIAL RESEARCH NEWS for May, 1965 (No. 51) reports on progress of research into coal combustion to improve the efficiency of power generation plants. Other items deal with a new distance measuring system, Aerodist, chemical analysis by atomic absorption spectroscopy and the problem of moisture condensation on canned foods. (Published bi-monthly by the C.S.I.R.O. Industrial and Physical Sciences Branch, 314 Albert Street, East Melbourne, C2, Victoria.)

THE STANDARDS ASSOCIATION OF AUSTRALIA has announced that Part 1 of the SAA Wiring Rules is under revision with a new edition being planned for January, 1968. Comment on the 1961 edition (as amended by amendments Nos. 1, 2 and 3) is invited from organisations and persons with experience in the electrical installations field and should be forwarded to the following address not later than 31st August, 1965: Engineer-Secretary, Committee EL/1, Wiring Rules, Standards Association of Australia, 157 Gloucester Street, Sydney, N.S.W.

LITTON INDUSTRIES advise the release of a new 64 page "Handbook of High Precision Potentiometers," some 40 pages of which are used to illustrate special model potentiometers and describe their application to various design requirements. Subjects covered include potentiometer computing circuits; trig, log and exponential functions; loading effects and tracking; and mil specs for shock and vibration. Also discussed are quadrature, noise measurement, and potentiometer definitions. This reference book is available on request on Company letterhead from Potentiometer Division, Litton Industries, 226E Third Street, Mount Vernon, N.Y.

SARGENT AND GREELEAF, INC., forward leaflets describing their Resonant Reed Relay, Resonant Reed Oscillator Control and Battery Holders for miniature electronic equipment. Leaflets or further details of these items may be procured by inquiry on Company letterhead to the export representatives, Hamos Company, 332 West 21st Street, New York, New York 10011, U.S.A.

STC COMPONENTS AND EQUIPMENT REVIEW for May, 1965 (Vol. 2, No. 5) gives details of multi-pole printed wiring connectors to ISEP standards, silicon rectifier units for valve replacement, gas tube surge protectors, midjet relays, reed switches and relays. Also included is a data table of higher-power silicon PNP transistors and a further article in the series "Choosing the Right Component." (Available from the Editor, Industrial Products Div., Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool, N.S.W.)

SAMPLE ENGINEERING SALES (N.S.W.) PTY. LTD. have data sheets and applications pamphlets for the "Devcon" range of "plastic steels," plastic packing and cold-curing urethane rubbers, manufactured by the Devcon Corporation of Danvers, Massachusetts, U.S.A. As explained by the data sheets and pamphlets, the range of materials made by the Devcon Corp. is very wide, and their applications range from repairing propeller shaft bearings of ocean liners to moulds and stamping dies for metals and plastics. (17 Anthony Street, Melbourne, C1, Victoria.)

B.C.N. AGENCIES PTY. LTD. advise that they are agents in Australia for Lowry-Croft Abstracts, of Illinois, U.S.A., who provide a regular information supply service to research workers in the fields of food processing, laser technology and microelectronics. The Lowry-Croft organisation searches continually through almost every available journal published world-wide in the fields concerned, and supplies the subscriber with 100-word or so abstracts of all relevant articles found—complete with full reference and filing details. Subscription to the "micro-electronics" abstract service is £11/5/ Australian per month or £135 p.a. (B.C.N. Agencies Pty. Ltd., 62 Wellington Pde, East Melbourne, C2, Vic.)

RADIOIRONICS for May, 1965 (Vol. 30, No. 5) has a tutorial article and series of experiments designed to teach the principles of semiconductor and transistor operation. Other articles deal with a thermoelectric converter for space vehicles and the design of low noise transistor RF amplifier stages. (The Amalgamated Wireless Valve Co. Pty. Ltd., P.O. Box 63, Rydalmere, N.S.W. Annual subscription rate 20/.)

CASSIETTES ADVERTISING

Advertisements in these columns cost only 5/ per line, each line contains the equivalent of five words each of nine letters. Minimum size of advertisements is two lines. **PAYMENT MUST ACCOMPANY ALL ADVERTISEMENTS EXCEPT THOSE PLACED BY ACCREDITED AGENCIES.** Your advertisement for the September issue must reach our office before August 6th. Address your advertisement to The Advertising Manager, **ELECTRONICS Australia**, Box 2728, G.P.O., Sydney.

FOR SALE

WHOLESALE'S STOCK. must be cleared. Barges, 1400 valves, including octal, many old types. Pots, Resistors, Branco Windings etc. Write for price list to **ALLEN, 201 Liverpool St., Sydney, N.S.W.**

TV Radio Electrical Sales and Service. Established 35 years, one owner. Under medical advice business must be sold. Going for value stock, workshop equipment and fittings. Further particulars and references. **DEAR'S RADIO, Northam, W.A.**

TAPE RECORDER BARGAINS. New and used machines. Buy from a technician, not a salesman. Free technical advice. All repairs and alterations. Recordings wanted to buy, any condition. Country inquiries welcomed. **TOMLIN'S RADIO, 528 Liverpool Rd., South Strathfield, N.S.W. 642-4215, Sydney.**

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R. & H. W/B Sin CRO, £20, R. & H. sine/square wave A/F osc. £10. COLLINS, 18 Natimuk Rd., Horsham, Vic.

QUAD stereo amplifier, Goodmans 3-way speaker system 6 3/4 cu. ft. in polished walnut cabinets. Thorens 135 turntable with MSSE cartridge. Copley £500, set £350 offer **J. HALL, 6124 Francis Street, Bondi, N.S.W.**

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LEAK Point One amplifier and 15in twin cone speaker. Garrard 301 arm and TPA12 arm. Tannoy car. in walnut cabinets, ex. cond. Cost £250, sell £100 or offer. **Fawcett, 287 Melbourne St., North Adelaide, 6-9790.**

AR8 Communications Receiver 140KC-20MC 6 bands, 240 volts. Good order. Spare parts. **Schurmer, 26 Carrigan St., Guildford, N.S.W. Phone 632-8150.**

ROLA 77 Mk.3 prof. 2 speed (15 and 7 1/2; ips.) tape recorder. Best offer write, **O.K. 75 Lyons Road, Drummoyne, N.S.W.**

EDDYSTONE 870A, 5-band receiver (150KC to 24MC). Best offer write, **O.K. 75 Lyons Road, Drummoyne, N.S.W.**

COSSOR TELECHECK Sweep and Marker Generator, as new. Best offer write, **O.K. 75 Lyons Road, Drummoyne, N.S.W.**

SINCLAIR COMPONENTS now in stock. See article page 49 July issue "Electronics Australia". X-20 (kit) £17/5s, X-10 (kit) £15/1s. Power units 56 and 65. Send S.A.E. for complete transistor list, mail order only. **Scott Enterprises, 10 Hurst Street, Seaview Downs, S.A.**

125th GUYED Steel Broadcast Tower. Any reasonable offer. 2KM, Kempsey.

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ARE you interested in experimental UHF-FM reception? Melbourne transmissions commence Monday. For information write "FM", Box 30 Toorak, Victoria. S.A.E. Please.

TAPE TO DISC Service. Quality Microgroove discs from your tapes. 15 years of service in this field. 10in discs, 32/6; 12in discs, 45/. Write for complete listings. **KAY-BEE RECORDINGS, Box 246, Murray Bridge, S.A.**

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SALARY: Within the range £1,129-£1,339 per annum to commence.

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DEPARTMENT OF CIVIL AVIATION, Regional Training School. A display of radio, electrical and mechanical equipment will be open to the public at the Department of Civil Aviation's Technical Training School, Carrington Road, Marrickville (Sydney) on Wednesday, 15th September, 1965, commencing 10 a.m. and concluding 8.45 p.m. This display should be of particular interest to boys and young men who may shortly be seeking careers in the above technical fields. Parents are also welcome. Advertisements will soon appear in capital city newspapers, inviting applications for training commencing early 1966 as Technician-in-Training (Radio) and (Electrical). For details contact the Department of Civil Aviation's Regional Headquarters in your own State.

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WANTED. Instruction Manual, with circuit diagrams, for HF Receiver, Group A, Type A.679-H. Price £10. Please state price required to **VK2APN, 31 Minimbah Road, Northbridge, N.S.W.**

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ADVERTISING INDEX

A.C.E. Radio	74, 114, 115, 116
Adcola Pty. Ltd.	55
A.R.T.C.	Back Cover
AKAI Electrical Co. Ltd.	78
Amateur Astronomer	67
Amplion (A'sia) Pty. Ltd.	87, 89
Amalgamated Wireless (A'sia) Ltd.	107
Inside Front Cover, 56, 107	
Amalgamated Wireless Valve Co.	18
Angus & Robertson Pty. Ltd.	126
Arrow Electronics Co. Pty. Ltd.	96
Asdic Stereo Specialty House and	
Brisbane Agencies	Inside Back Cover
Atram Pty. Ltd.	61
Austral Instruments	113
Australian Publishing Co.	124
Belling and Lee Aust. Pty. Ltd.	48
B.I.E.T.	17
Bright Star Radio Pty. Ltd.	41
Broadway Electronics Pty. Ltd.	2, 3
Broughton, Peter	75
Brown and Watson Pty. Ltd.	66
Channel Master Pty. Ltd.	110
Classic Radio	98, 99
Classified	127
Convoy Imports	50
Classic Tape Recorders	54
Deitch Bros.	104
Direct Disposals	118
Ducon Condenser Pty. Ltd.	20
Enceel Electronics	15
Ericsson, L. M. Pty. Ltd.	50
Ferrier Pty. Ltd.	31
Fairchild (Aust.) Pty. Ltd.	76
Ferguson Transformers Pty. Ltd.	40
G.R.D. Instruments Pty. Ltd.	86, 101
General Accessories Pty. Ltd.	52
George Newnes (Aust.) Pty. Ltd.	118
Goodmans	100
Gray, Simon Pty. Ltd.	22, 102
H.B. Radio Products	103
Ham Radio Suppliers	108
Homecrafts Pty. Ltd.	62, 63
International Correspondence School	47
Jacoby, Mitchell and Co. Pty. Ltd.	26, 82
JH Reproducers Pty. Ltd.	81
Kodak Pty. Ltd.	84
Kuenzli, Ernest Pty. Ltd.	95
Lafayette Electronics	120
McLellan, W. J. Pty. Ltd.	60
Magnetic Sound Industries	59
Magrath, J. H. & Co. Ltd.	58
Manufacturers Special Products	27, 32, 33
Master Electrics Pty. Ltd.	46
Mastersound Sales Pty. Ltd.	88
Mullard (Aust.) Pty. Ltd.	8
National Radio Supplies	122, 123
New Era Products	67
O'Rourke Ind.	103
Pye Pty. Ltd.	112
QUAD	106
R.A.A.F.	30
R.C.A. of Aust. Pty. Ltd.	80
R.C.S. Radio Pty. Ltd.	94
Radio Dispatch Service	127
Radio House Pty. Ltd.	72
Recorded Music Salon Pty. Ltd.	36
Rola Special Products Pty. Ltd.	42, 70
Rowe, H. and Co. Pty. Ltd.	34
Selex Decal Pty. Ltd.	97
Sonic Laboratories	105
Standard Components Pty. Ltd.	111
Stoffs Correspondence School	112
Strato Communications Pty. Ltd.	119
Sure Brite Picture Tubes	95
Swaps Mail Orders	6, 79
Tecnic-Electronics Pty. Ltd.	42
Telecomponents Pty. Ltd.	90, 91
T.O.S.C.A.	92
Triton Tape Co.	10
Union Carbide Aust. Ltd.	57
Unifed Radio Distributors	24
University Graham Instruments	38, 68
Warburton Franki Pty. Ltd.	66
William Willis Co. Pty. Ltd.	93
Wonder Wool Pty. Ltd.	44, 54
Zephyr Products Pty. Ltd.	

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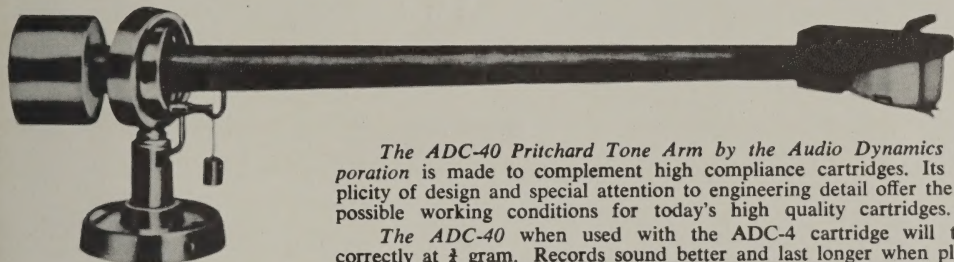
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ADC-40 PRITCHARD TONE ARM FOR HIGH COMPLIANCE CARTRIDGES



The ADC-40 Pritchard Tone Arm by the Audio Dynamics Corporation is made to complement high compliance cartridges. Its simplicity of design and special attention to engineering detail offer the best possible working conditions for today's high quality cartridges.

The ADC-40 when used with the ADC-4 cartridge will track correctly at $\frac{1}{2}$ gram. Records sound better and last longer when played under these conditions.

THIS advanced-design tone arm incorporates many features which will be of interest to enthusiasts.

Low Moment of Inertia: Because of its low inertia, the ADC-40 tracks each side of the record groove perfectly. Sudden disturbances, such as warps on the playing surface, will not dislodge the stylus from the groove, even when it is tracking at as low as $\frac{1}{2}$ gram.

Side Thrust Compensator: A small weight exerts a constant force on the tone arm away from the centre of the record. This counteracts the inward pull of the record groove against the stylus. Thus the stylus maintains even pressure on both sides of the groove wall, and better stereo balance and tracking result from the use of the ADC-40.

Miniature Ball Bearing Assembly: The ADC-40 uses single thrust ball bearings at only four points. These high quality bearings are virtually frictionless. Thus the cartridge's tracking characteristics are unimpeded.

Non-Drag Wire Guide: A unique wire guide is so arranged that the ultrafine lead wires twist along their own axis. Thus the wire cannot exert measurable drag on the arm at any point.

Walnut Arm Suppresses Resonance: The body of the arm is accurately machined from specially treated walnut which suppresses extraneous resonances and ensures that the arm adds no "colour" to the reproduction.

Other Important Facts: The rear counterweight is close to the pivot point

of the ADC-40, allowing installation in areas of narrow rear clearance. The plug-in head accommodates all cartridges. Arm installation is quick and accurate. A cable assembly plugs into the arm base. No soldering or wiring is necessary.

An arm rest is built into the rear section of the arm, easily located and out of the way.

SPECIFICATIONS:

Arm length	10 5/8" overall
Pivot to stylus tip	9"
Rear overhang	1 3/4" maximum
Fundamental resonance	6 cycles per/sec with ADC-4 cartridge



ADC-40 Pritchard Tone Arm
is priced at £20.

ADC CARTRIDGES

ADC cartridges are distinguished by the exceptionally low mass of the moving system, which is genuinely below all others and results in superior square wave response.

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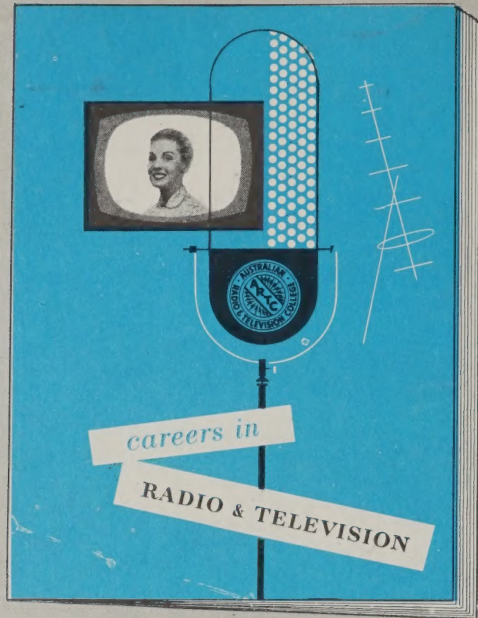
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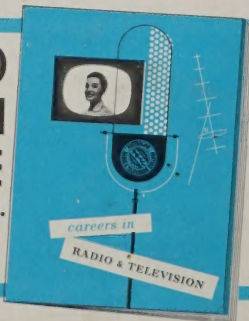
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